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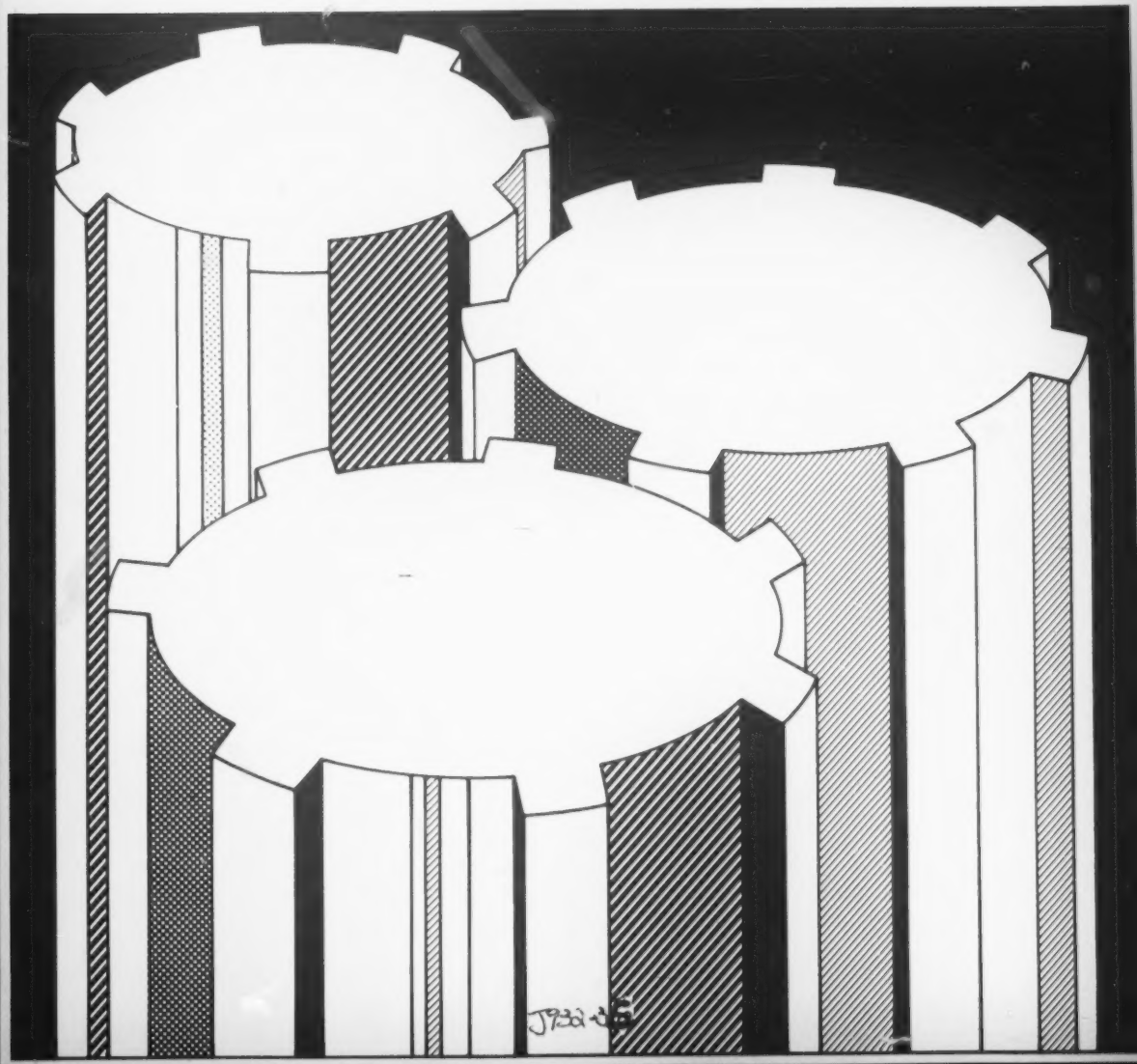
New Directions for the Nation's Public Works

As Required by Public Law 98-501



CBO STUDY

NEW DIRECTIONS FOR THE NATION'S PUBLIC WORKS

The Congress of the United States
Congressional Budget Office

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PREFACE

Concern is widespread over the condition of the nation's public works infrastructure. At the request of Senator Lawton Chiles, Chairman of the Senate Budget Committee, this study assesses the federal programs for highways, mass transit, aviation, waterways, and wastewater treatment, and discusses policies that the Congress might consider to improve the effectiveness of these programs. In keeping with the mandate of the Congressional Budget Office to provide objective analysis, it makes no recommendations.

This study also fulfills the requirement of Public Law 98-501 that the Congressional Budget Office review the findings of the National Council on Public Works Improvement. The body of this paper considers some of the broader issues raised by the Council's final report, *Fragile Foundations: A Report on America's Public Works* (1988); the appendix focuses more specifically on the Council's findings.

Michael Deich and Jenifer Wishart of CBO's Natural Resources and Commerce Division wrote the report under the supervision of Everett M. Ehrlich. Daniel Kaplan, Larry Ozanne, and Robin Seiler of CBO made substantial contributions to the report. Helpful suggestions were received from Mark Dayton, Theresa Gullo, Robert Hartman, Linda Radey, Deborah Reis, and Mitchell Rosenfeld, also of CBO. The authors are grateful for the critical comments and helpful remarks of David Williams and Steven Hornburg of the Senate Budget Committee staff. External reviewers offering valuable comments included Harry B. Caldwell, David L. Lewis, Regina McElroy, and Arlee Reno. The manuscript was edited by Francis S. Pierce. Gwen Coleman typed the many drafts, and Nancy H. Brooks and Kathryn Quattrone prepared the report for publication.

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September 1988

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SUMMARY AND INTRODUCTION

The importance of the nation's public works infrastructure has been demonstrated recently by mounting delays in highway and air travel and by dramatic episodes such as the closing of the Williamsburg Bridge in New York City. While concern for the state of infrastructure is widespread, no consensus yet exists on how to improve the effectiveness of infrastructure programs or how to pay for them. This report examines ways to reconcile the need for a sound infrastructure with the Congress's commitment to fiscal restraint.

In the last three decades, the federal government has greatly expanded its role in providing public works infrastructure. While continuing its century-old commitment to build major water resources projects, the government has also subsidized state and local investment in transportation and in environmental facilities. By 1988, federal infrastructure outlays totaled $26.6 billion (see Summary Table).

Over the years, the Congress has periodically assessed the adequacy and efficiency of these programs. Recently, the focus of the reviews has shifted from the problems and prospects of individual programs to issues common to infrastructure policies generally. In 1983, for example, the Joint Economic Committee of the Congress conducted a wide-ranging survey of the nation's infrastructure problems. In 1984, the Congress established the National Council on Public Works Improvement to assess the state of the infrastructure. The Congressional Budget Office is required by Public Law 98-501 to review the findings of this Council. Accordingly, the study reviews some of the issues raised by the Council's final report, *Fragile Foundations: A Report on America's Public Works* (1988); the appendix focuses more specifically on the Council's findings.

Two difficulties arise in attempting an overall assessment of infrastructure programs. The first is the difficulty of defining infrastructure. This report analyses five major infrastructure modes--highways, aviation, mass transit, wastewater treatment, and water transportation--that are consistent with a definition of infrastructure as those facilities that provide a foundation or basic framework for the

national economy, and in which federal policy plays a significant role. A sixth area consistent with this definition--groundwater and surface water resources--will be addressed in a future CBO report. This definition excludes some facilities often thought of as infrastructure--such as public housing, government buildings, private rail service, and schools--and some environmental facilities (such as hazardous or toxic waste sites) where the initial onus of responsibility is on private individuals.

The second difficulty arises in determining how well a particular set of policies meets the variety of objectives that governments pursue in supporting infrastructure development. Here different viewpoints enter--those of economic efficiency, social policy, and national defense, among others. This study is written from an economic perspective and appraises programs in terms of their cost-effectiveness. At the same time, it recognizes that criteria of economic efficiency may have to give way at times to social or political considerations.

SUMMARY TABLE. FEDERAL INFRASTRUCTURE SPENDING, 1988
(In billions of dollars)

Infrastructure Area	Outlays	Percent of Total
Highways	13.64	51
Mass Transit	3.50	13
Aviation	5.31	20
Water Transportation	1.17	4
Wastewater Treatment	2.94	11
Total	26.56	100

SOURCE: Congressional Budget Office.

NOTE: Excludes spending for water resources other than water transportation.

The extent to which the different infrastructure areas examined here share common characteristics is striking. While important differences exist, the infrastructure areas (or "modes") can be thought of as alike in four ways: they have *common origins*, they have made *common achievements*, they face *common challenges*, and their problems may have *common solutions*. Recognizing these common characteristics should help to set new directions for infrastructure programs.

COMMON ORIGINS

The nation's infrastructure programs were created to serve many purposes, but federal involvement was motivated by three principal concerns. First was the need for coordination. Federal programs in highways, airports, air traffic control, and inland waterways were undertaken because no other jurisdiction could plan a system of such facilities from a national perspective. If left to their own devices, for example, localities would underinvest in roads (since many of the benefits of these investments accrue to people outside their boundaries) or in air traffic control (where a single national system is needed to make commercial air transit possible). Federal programs were designed to lead localities to make investments from a national rather than a local perspective, or to make national investments where localities otherwise would have little reason to do so.

The second motivation for federal involvement was to spread the financial burden. For example, after requiring that all municipalities clean their water to a minimum standard, the federal government provided funds to help them build wastewater treatment plants that would attain this standard. Similarly, when faced with a wave of private transit financial failures in central cities, the Congress enacted a federal mass transit program to lighten the burden of putting these fleets back into operation.

A third motivation was to promote social policy goals. Inland waterways, ports, and water supply projects were all subsidized as a way of promoting or revitalizing economic development in individual regions. Mass transit was seen as part of a policy to revitalize urban

cores. Mass transit, aviation, and highways were all conceived, in part, as ways to increase the mobility of the population and to integrate the various regions of the country. In this sense, infrastructure programs have actively sought social goals as a collateral benefit of economic expansion.

COMMON ACHIEVEMENTS

The infrastructure programs share common achievements in two respects: almost all have accomplished their initial goals to a great degree, and together they have forced state and local governments to develop bureaucracies capable of planning, administering, and financing these areas of public life--so much so that many states are now widely recognized as imaginative infrastructure managers.

While all the nation's infrastructure facilities may never be "finished" since there will be ongoing needs for maintenance, expansion, and replacement, significant accomplishments have been made in all areas of infrastructure. The Interstate Highway System as currently planned is about 98 percent complete, and all funds needed for its completion will be obligated by 1993. The United States now has more highways per person than any other industrialized country; its roads are used at only about 15 percent of capacity in rural areas and 40 percent of capacity in urban areas. Water supply projects have led to the regional development of the West, so much so that the Bureau of Reclamation now believes that adequate water supplies often can be achieved more efficiently through conservation than through new construction. About 90 percent of the wastewater treatment plants needed to meet current regulatory standards have been built; as a result, the ongoing deterioration in water quality prevalent only two decades ago has been arrested.

The standard of achievement is not uniform. Mass transit programs have often encouraged localities to apply incorrect solutions to their transit problems: new systems in Miami, Washington, D.C., Pittsburgh, and Atlanta have all raised the cost of providing transit while attracting far fewer riders than predicted. Nationwide, the use of trains and buses continues to decline except for trips from suburbs to urban centers, but such trips now account for only one-seventh of

trips to work. Although the largest urban rail systems--New York City, Chicago, Philadelphia, and Boston--are in need of renovation, many smaller urban systems have more capital equipment than they can use although they are still drawing operating subsidies from the federal government. In air transportation, the antiquated traffic control system is a major source of delays, and the rapid recent growth in air traffic has brought peak-hour congestion to the airports.

The federal government's initiatives have also led state governments to become more productive partners in infrastructure management. State governments are now more capable of managing their infrastructure systems and many are widely recognized as being innovators in infrastructure finance.

COMMON CHALLENGES

The various infrastructure modes confront, each in its own fashion, similar sets of challenges. The most important of these may be the transition from an era of construction to an era of management. Just how well federal infrastructure programs perform in this new era will depend, in part, on the incentives that the programs offer to infrastructure users and to state and local infrastructure managers. Federal programs now also confront an institutional environment far different from that for which they were designed.

Management

The transition from an era of construction to one of maintenance, rehabilitation, and replacement is evident in almost all modes. In highways, for example, the rate of return on maintaining the condition of the federal-aid highway system is on the order of 30 percent to 40 percent, while the rate of return on new construction, save in certain urban areas, is very low. For aviation, the most pressing general need is to modernize the air traffic control system.

In mass transit, newly constructed systems have not reversed the decline in transit's share of commuting. Nationwide, mass transit operates at a low level of productivity, and transit fleets are too large. A

contradiction may be seen in that the older major urban systems need repair, while nationally an unobligated balance of $850 million sits in transit accounts for lack of new construction projects that qualify for aid.

Similarly, about half of the locks and dams on the inland waterway system will have exceeded their design lives by the year 2000. Many of these locks will require major rehabilitation.

Construction is not a thing of the past, but where construction is needed (as it is to some extent in all modes), the needs are regional rather than national. Moreover, the needs are typically for alleviating congestion rather than anticipating or promoting growth. The area farthest from its initial goal may be wastewater treatment: the Environmental Protection Agency estimates the remaining need for wastewater treatment plants at a total construction cost of $76 billion between now and 2005. Perhaps half of these outlays, however, would be needed even in the absence of federal statutes.

Incentives

As currently structured, federal infrastructure programs fail to provide either infrastructure users or state and local managers with incentives to make efficient choices. Since the benefits of using facilities are not tied to the costs of providing them, federal programs lead to inflated perceptions of the demand for infrastructure. The current programs also give state and local managers no incentives to solve infrastructure problems with "nonstructural" approaches, and often encourage them to select projects that create local, rather than national, benefits.

Infrastructure managers must not only decide what facilities to build, but also price them in a way that will optimize their use. Charging prices that are too high would lead to underuse and reduce the productivity of the infrastructure investment, while making roads, ports, and mass transit available without charge would lead to their overuse and rapid deterioration. In only two of the seven major federal programs--highways and airports--are fees now high enough to defray most of the federal spending. And even in these programs, some users--notably, operators of heavy trucks and private planes--

pay less than their share of costs, while other users--light truck operators and airline passengers--make up the difference by paying fees that recover more than the costs they create. In each of these programs, below-cost pricing leads users to request more infrastructure services than they are willing to pay for, while planners get an exaggerated perception of investment needs from these misleading signals about infrastructure demand.

Water transportation projects are conspicuous in their failure to charge users for the costs of water transportation. The 1986 Omnibus Water Resources Development Act required that user fees finance up to 50 percent of the costs of new construction, but in 1988 user fees still covered only 21 percent of the Corps of Engineers construction costs on inland waterways and 9 percent of total Corps costs for inland navigation. Thus, users of the inland water system are subsidized while those who use competing freight modes--particularly rail--are not. Water projects also deliver water that is allocated through historical rights at prices far below costs, leading to overconsumption and underinvestment in conservation. Ironically, this overconsumption of water, particularly in agriculture, increases water runoff and, in turn, water-based pollution and the need for treatment of rivers and streams.

Another set of common problems arises from the incentives given to state and local infrastructure managers. First, the structure of federal financial assistance leads state and local infrastructure managers to substitute federal funds for their own. This phenomenon of "fiscal substitution" takes place in a variety of infrastructure modes, most notably in wastewater treatment (where federal grants appear not to have led to more rapid construction of wastewater plants and may have led to actual deferrals of plant construction). Substituting federal for local funds also occurs in highway programs outside the original Interstate system (where statistical evidence suggests that federal assistance has had far less than its maximum impact).

Second, even where it has truly added to spending, federal assistance may have altered the choices made by local officials without satisfying federal interests. In mass transit, for example, where capital purchases are subsidized to a far greater extent than are maintenance expenditures, municipalities regularly retire buses before the end of their useful lives and purchase new equipment with federal

funds in excess of service requirements. In wastewater treatment, plants have commonly been built to subsidize local economic expansion rather than to service current needs.

Institutions

A final challenge that confronts all infrastructure programs is a changing institutional environment. Regions that once depended on inland water transportation now have new alternatives as a result of changing technology and the deregulation of most transportation industries. The deregulation of air travel has led to a more efficient system of "hubs and spokes" for airlines, requiring airports to be more flexible while at the same time leaving them more vulnerable to changes in airline routing. State and local governments, and the capital markets that serve them with funds, are learning how to manage and appraise infrastructure projects. In addition to the traditional general obligation bonds, many state governments now employ new devices such as bond banks, revolving loan funds, and special taxing authorities to finance their projects.

COMMON SOLUTIONS

The chapters that follow evaluate a wide range of options intended to make federal infrastructure policies more responsive to current challenges. While differing in their details, most of these options stem from four approaches: pricing infrastructure services more efficiently; targeting federal assistance more effectively; assigning more infrastructure responsibilities to states and localities; and fostering greater competition among different forms of infrastructure for federal funds. These approaches seek more cost-effective infrastructure programs. Cost-effectiveness is not the only goal of infrastructure spending, however, and sometimes may conflict with other goals such as income redistribution or the economic development of particular regions.

Pricing Infrastructure Services

Better pricing of infrastructure services--that is, more reliance on user fees--would help to achieve a number of goals. Better pricing could reveal how much people value different infrastructure services; by giving managers better information about the cost-effectiveness of different projects, user charges could enable them to improve their investment decisions. Proper pricing could also ameliorate congestion, whether that congestion is specific to particular localities (as with highways and inland waterways) or to particular times of day (as in aviation). Varying airport landing fees by time of day, for instance, would shift some traffic to off-peak hours. Similarly, user fees at locks and dams on the inland waterways could cause some cargo to be shipped by rail or other alternative systems.

Most existing user fees are designed simply to recover some portion of infrastructure costs. While increasing those fees could help finance infrastructure investment, it would do little to increase the efficiency of that investment. Most current fees--the highway gas tax, the inland waterways fuel tax, the harbor maintenance tax, the airline ticket tax--are the same throughout the country, although both the demand for services and the cost of providing them vary dramatically by place and time. Current fees reveal little about how users value particular facilities and thus do little to direct investment toward projects that benefit users most. Similarly, landing fees that do not vary with the time of day can recover an airport's relevant operating costs but do little to reduce peak-hour congestion. In many cases, efficient infrastructure pricing would require changes in the structure and the level of fees.

An increased reliance on user fees has two drawbacks. First, the efficient use of facilities may not be the only goal of an infrastructure program. To the extent that federal subsidies are intended to provide nonmonetary income transfers (as in the cases of federal support for water supply, mass transit, and aviation services to small towns), increased user fees clearly would be at odds with this purpose. Sometimes infrastructure programs are intended to spur regional economic development, and in such cases user fees would reduce the regional subsidy.

Targeting Federal Assistance

The fact that federal costs are set at fixed shares in most forms of infrastructure implies that national benefits are equal for every project within each mode. In reality, some projects offer greater national benefits than others. One way to improve the targeting of federal assistance would be to vary the share of federal costs according to the expected benefits of each project. This could be accomplished by negotiating the federal share on a project-by-project basis or by defining different shares for different subclasses of projects ("tranches"). The greatest drawback would be the administrative costs involved in conducting many negotiations. Negotiating aid could also make federal aid less stable over time, adding an element of risk to state and local investment planning.

Targeting could also be improved by restructuring programs so that benefits would go directly to the intended beneficiaries. For example, one purpose of urban mass transit is to provide mobility to poor people; this assistance could be furthered by issuing transportation vouchers rather than subsidizing all ridership on mass transit systems. On the other hand, when a program serves a number of purposes (for example, mass transit is also intended to promote urban economic development and reduce congestion and pollution), it may be more efficient to provide services rather than cash.

Assigning More Responsibilities to State and Local Governments

State and local planners may be able to make better decisions than national authorities, given their proximity to local problems and conditions. This advantage will continue only so long as their decisions do not have a significant impact outside their jurisdictions. Where the benefits of infrastructure programs accrue predominantly outside a state's jurisdiction, the federal government may have to act in the interests of other states.

For programs aimed at creating strictly local benefits, state and local governments may be the appropriate level of decisionmaking. Some may argue that mass transit, for example, is not a national infrastructure problem, but a local one. The original intent of the federal mass transit program was to help municipalities assume responsi-

bility for bankrupt private systems. With that goal accomplished, additional transit investments arguably could be funded at the state and local levels. Similarly, state and local governments already finance all aspects of port development other than dredging. These services could be contracted from the private sector rather than provided on a subsidized basis by the Corps of Engineers.

Even when the benefits of infrastructure programs are primarily local, however, asking states and localities to take on greater financing responsibility might be inconsistent with the social goals of these programs (such as income redistribution or regional economic development). Moreover, increasing state control over infrastructure spending would tend to substitute state spending preferences for federal preferences.

Fostering Greater Intermodal Competition

Investment in all classes of infrastructure could be improved by having federal grants foster competition among infrastructure programs for public and private resources. Among the approaches examined here are:

- Allowing states to trade in some portion of their categorical grants in any one account for funds in another account, perhaps on less than a dollar-for-dollar basis.

- Merging the major parts of all infrastructure programs into one broad-purpose "public infrastructure" block grant.

- Creating a national infrastructure financing facility that could perform a range of roles, from formal screening of all large-scale federal projects to financing large facilities on a project-by-project basis.

All of these options would seek to tailor federal infrastructure spending more closely to local conditions. They would give more weight to local interests in allocating funds among infrastructure programs. Most of them would accomplish this by giving states and localities greater flexibility in apportioning funds among infrastructure categories. Easing conditions on the use of federal funds

implicitly assumes either that the national benefits of all infrastructure programs are equal or, more likely, that federal interests can be better pursued by allowing greater variation in the response to local infrastructure problems.

Another argument in favor of greater state and local control is that categorical programs no longer need to be as narrowly defined as they formerly were. Nearly all categorical grant programs for infrastructure were originally designed to create national systems and to marshal state involvement. In large measure, both of these goals have been achieved. Moreover, as capital markets have become more diverse and borrowers more sophisticated, a broader set of projects can now be funded locally.

To be effective, however, these options would require reorganizing the federal and state infrastructure bureaucracies, which have been designed to evaluate only projects within particular infrastructure categories. At the extreme, of course, merging all programs into a single infrastructure system might deny the legitimate differences among modes or overlook the fact that some level of investment in each is a stipulated national goal regardless of economic merit.

Finally, many of the benefits of greater competition for resources among the infrastructure modes could be achieved by requiring federal program managers to present more explicit statements of goals, to make more frequent evaluations of past projects, and to use common standards in measuring such variables as the cost of accidents, the value of health improvements, the value of time lost to delay, or the discount rate. Under the current budgeting system, agencies are allowed to plan programs on the basis of the current level of services offered. But circumstances change, as do rates of return and the degree to which agency missions have been accomplished. Requiring agencies to prepare more detailed "sector plans" that took explicit account of the returns on their proposed investments would allow the Congress to make decisions among alternative programs and thus improve the allocation of national resources devoted to infrastructure.

CHAPTER I

HIGHWAYS

The national highway system is in place. Federal leadership during "the Interstate era" helped to double the capacity of the national road system. During the 1990s, the traditional federal role of shouldering most of the risks, as well as the costs, of highway development may no longer be necessary in view of the high economic benefits now apparent in sound highway maintenance and investment policies. Federal policies need to change their focus from constructing a highway system to keeping roads in good order and the costs of road transport low. One alternative would be to withdraw federal assistance. Another would be to concentrate on encouraging states and localities to undertake projects with the greatest economic benefits.

THE CHANGING FEDERAL ROLE

Federal interest in developing a national highway system dates from early in the automobile age. Financial support was first provided to the states by the 1916 Rural Post Roads Act, which authorized federal grants to pay for up to half the costs of constructing rural roads used to deliver the mails. At that time only about one-tenth of the roads were paved, and only about 4 million automobiles were registered--about one for every 30 people.

The 1916 act set out some broad principles that have persisted. A large share of highway development costs was to be borne by the federal government, but the ownership, management, and maintenance of highway networks would remain with the states. Federal highway spending was authorized for multiyear programs in order to support multiyear construction, and federal engineering and other criteria were established for the projects eligible for aid. The aid was to be apportioned among the states according to formulas based on area, population, and other broad factors.

At first, federal highway programs were financed from general revenues. The states were the first to adopt user taxes for highways: as early as 1916, some $26 million of the $87 million in state highway spending came from this source. In 1932 the federal government followed the states in imposing a tax on gasoline fuels, and although the revenue was not formally earmarked for highway programs until 1956, spending and gasoline tax revenues tracked closely in following years. After the Highway Trust Fund was set up in 1956, user financing became a basic principle of the federal highway program.

Changes in the program since the early days have, for the most part, altered the yardsticks for granting aid, or the amounts available, but not the underlying federal and state roles. Even the Federal Aid Highways Act of 1956 adhered to these broad principles in setting up the national plan to construct the Interstate system and its complementary main road networks. Program changes in the 1982-1984 period raised the level of federal financing and taxes, and apportioned the burden of taxes more in line with the costs different users impose, but left unchanged the responsibilities of federal and state highway departments in managing the national highway system.

Two significant federal incursions into highway management and operations occurred in the early 1970s. First, following earlier studies and legislation, the 1966-1970 period saw a host of new laws covering vehicle standards, traffic operations, and highway design that firmly established a federal interest in safe highway operations. Second, about the same time, the federal programs were broadened to cover major highway maintenance. A program of federal aid for bridge rehabilitation was authorized in 1970 (under highway safety legislation), and federal funds were made available for so-called "3R projects" (restoration, resurfacing, or rehabilitation) on federal-aid highways beginning in 1974. By and large, this expanded federal role was paid for out of reduced spending on construction elements of the federal program and by additional spending from federal funds.

Current law continues these themes. The Surface Transportation and Uniform Relocation Assistance Act of 1987 reauthorized the federal-aid highway program much as it had been throughout the 1980s, and extended authorization for completing the Interstate highway system through 1993. Table 1 describes the current program. Federal

TABLE 1. FEDERAL PROGRAMS FOR HIGHWAYS, 1987-1992

Program	Budget Authority 1987-1992 (Billions of current dollars)
Highway Trust Fund	
Federal Highway Administration	
Interstate construction	17.0
Interstate restoration, resurfacing, rehabilitation, and reconstruction	14.1
Interstate substitute projects	3.7
Primary system	11.6
Primary minimum[a]	0.3
Secondary system	3.0
Urban system	3.8
Indian reservations	0.4
Forest highways	0.3
Public lands highways	0.2
Park roads and parkways	0.3
Minimum allocation[a]	4.1
Emergency relief	0.6
Bridge replacement and rehabilitation	8.2
Hazard elimination	0.9
Railroad-highway crossings	0.8
Demonstration projects and studies	0.9
Highway-related safety grants	0.1
Highway safety R&D	0.1
Subtotal, FHWA	70.0
National Highway Traffic Safety Administration	
Highway traffic safety	0.7
Operations and research	0.2
Subtotal, NHTSA	0.9
Total, Highway Trust Fund	70.9
Federal Funds	
Railroad-Highway Crossings	0.1
Waste Isolation Pilot Project	0.1
Total, Federal Funds	0.1
Total, 1987 Act	71.0

SOURCE: Congressional Budget Office, based on the Surface Transportation and Uniform Relocation Assistance Act of 1987.

a. The Act authorizes such sums as may be necessary. Estimates are based on information provided by FHWA.

spending for operations and maintenance covering research, safety, and 4R work--is now just over 40 percent of all federal aid.[1] Moreover, the federal interest in operational issues extends even farther, through federal priorities favoring projects that incorporate safety-effective design features and through federal studies of operations and maintenance problems.

ACHIEVEMENTS OF THE HIGHWAY PROGRAM

Both the short-term and long-term goals of the federal government in the highway sector have been mostly achieved. The Interstate system is virtually finished; the rehabilitation work needed is well in hand. But increasingly the highways are not financed by taxes on highway users, and the priorities set for capital spending are often unrelated to the merits of the investment projects.

An assessment of the achievements of the national highway program involves two questions:

- o Is the system complete? The basic objectives of highway development set out in 1956 were to provide users in all regions with access to trade and travel opportunities through the highway network.

- o Does highway transportation cost the right amount? Are highways maintained so as to minimize the overall costs of highway transportation, and do highway users pay for the damage they do to roads and for the other costs they impose on the system?

System Development

The goal set out in 1956--to develop a national highway network based on Interstate, Primary, and Secondary highway systems--has largely been attained. In the 70 years of federal highway financing, the

1. The fourth R, reconstruction, was added in 1982.

overall length of the highways has changed little, from 3 million miles to just under 4 million. But access to highways in this country (measured as route miles per capita) stands at about three times the level in Japan and Britain and one and one-half times that in the much more densely settled countries of Europe. Outlays in this century to improve the quality of roads--principally by paving them and by constructing multilane limited access routes--have totaled $1 trillion (in 1982 dollars), and 40 percent of this has come from federal budgets. These outlays have about doubled the capacity of the highway system, thereby further increasing the availability of highway transportation services.

The capacity of the existing major network is broadly sufficient for its traffic. Nationally, 85 percent of rural highway capacity is unused and the main urban networks are only 40 percent used on average. But 45 percent of urban interstates and one-third of other main urban arterial highways have use rates above 70 percent.[2] These high levels of urban traffic congestion are found primarily in the systems of only nine states--Alabama, California, Connecticut, Georgia, Massachusetts, New Jersey, New York, Pennsylvania, and Texas.

Highway managers are demonstrating diminishing interest in construction projects. Beginning in 1970, federal policies permitted or encouraged trade-ins from highway construction in urban areas to transit projects, and also allowed federal aid to be transferred among highway systems (though not between urban and rural apportionments).[3] Under the Interstate withdrawals program of 1973-1984, for example, states traded in or withdrew from construction some 343 miles of planned Interstate highways, leaving only 940 miles in remaining gaps on the designated system. Since 1976, over $6 billion has been transferred from Interstate construction to transit projects.

Finally, the system has been able to assimilate innovations in highway technology that lower the cost of transport. The national truck network covers 181,000 miles of Interstate and Primary highways and can carry the largest double trailer trucks between the largest road freight centers without requiring major reconstruction. The

2. Federal Highway Administration, *Highway Statistics 1986* (1987), Table HM-61.

3. Federal Aid Highway Acts of 1970 (P.L. 91-605) and 1973 (P.L. 93-87).

structural adequacy of the highway system to cope with developments in trucking technology is not seriously questioned.

Highway Transport Costs

There are two indications that national highway spending could be reallocated in ways that would lower transportation costs. First, much of the federal highway maintenance budget is spent where it is little needed and has relatively little effect on reducing highway transportation costs. Second, dedicated highway taxes are not high enough to cover all of the maintenance spending, and truckers in particular underpay for the damage they cause to roads.

Returns on Highway Maintenance. Federal Highway Administration (FHWA) data show a broad improvement in highway pavement conditions since 1983 (see Figure 1). This reversed a general slump in pavement ratings after 1981. Most of the Interstate network has been restored to generally better condition than in the mid-1970s, while all other parts of the network are at least slightly better than in 1975. Moreover, the urban Interstates, by far the busiest sectors (measured in millions of vehicle miles of travel per year), are generally in better shape than other systems, which was not the case in 1983.[4]

Such broad improvements in the condition of highways translate directly into lower costs for highway transport. The Federal Highway Administration estimates that reductions in vehicle operating costs have been as much as 3 percent to 5 percent on urban Interstates and freeways, and just under 2 percent overall.[5] Nationally, this means that the $652 billion outlay for highway transportation in 1986 ($216 billion for freight, and $436 billion for passenger travel) would have been $7 billion to $8 billion higher without the improvement in highway pavements. If the time savings from faster journeys are valued at around $5 billion a year, the return on highway rehabilitation in 1984 and 1985 was 43 percent (see Table 2).

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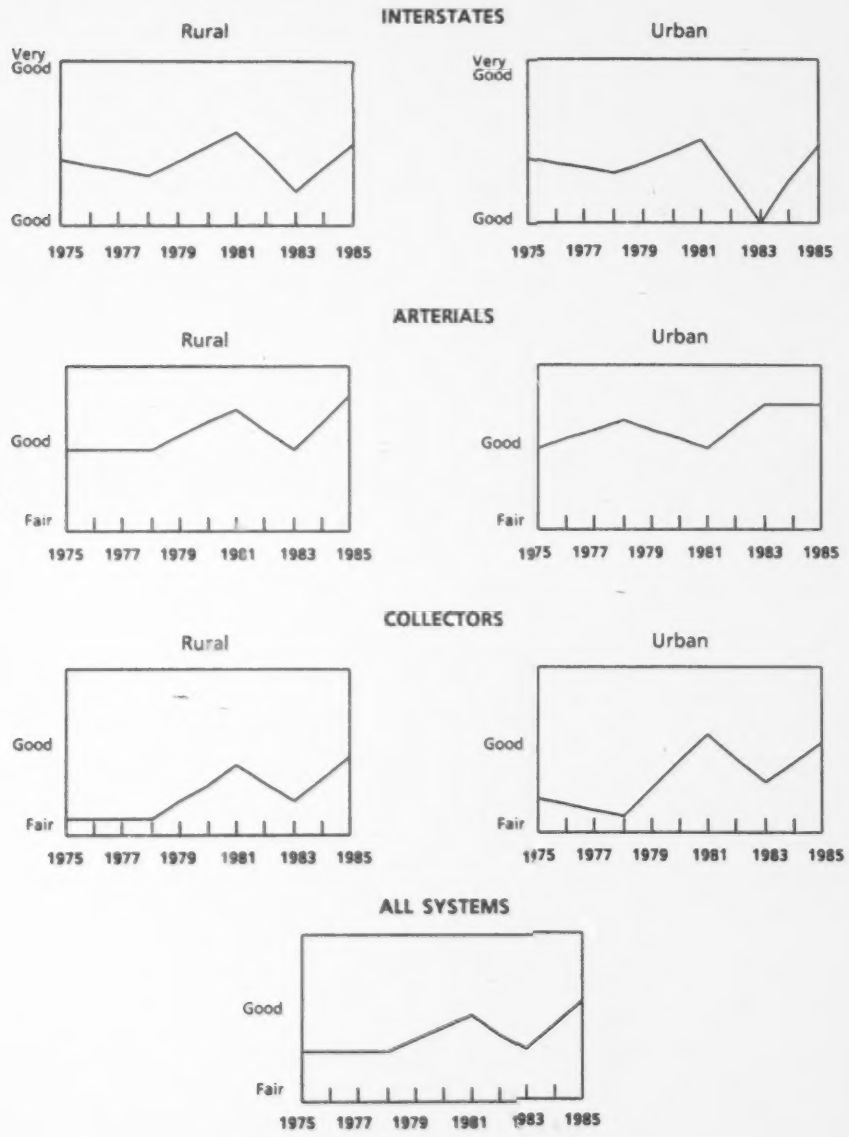
4. The data do not cover local roads, but they include 360,000 miles of mostly minor collector roads as well as the federal-aid network. Hence, they are representative of the most used portions of the national network.

5. Federal Highway Administration, *The Status of the Nation's Highways: Conditions and Performance*, Report of the Secretary of Transportation to the United States Congress (June 1987).

Figure 1.
Changes in Average Highway Pavement Conditions, 1975-1985



SOURCE: Federal Highway Administration.

Such returns on investment reflect real reductions in the costs of doing business in any community. Thus they measure increases in personal and business income that become available, as a result of highway projects, for financing investment and consumption purchases generally. The lower costs of transportation may also open up new business opportunities. But these increases in income are obtained from tax spending that, in the absence of a highway program, could also be used for general consumption and investment purposes, or for attracting new businesses to a community. To benefit from highway spending, the repayment in terms of reduced transportation costs should afford at least as good a return as if the same amounts had been spent for other purposes.

TABLE 2. INVESTMENT AND RETURNS ON HIGHWAY MAINTENANCE, 1984-1985 (In billions of 1986 dollars)

Highway System	Vehicle Miles of Travel (Billions)	Capital Maintenance Cost, 1984-1985[a]	User Cost of Travel, 1985[b]	Percent Return on Investment[c]
Rural Systems				
Interstates	154.1	3.4	72.8	-4
Other Principal Arterials	145.9	3.4	71.1	16
Minor Arterials	136.9	3.3	68.1	28
Major Collectors	163.2	2.3	90.5	7
Minor Collectors	43.3	0.8	27.0	57
All Rural Systems	643.4	13.1	329.4	16
Urban Systems				
Interstates	216.4	4.5	91.4	31
Other Freeways and Expressways	97.4	1.1	41.4	117
Other Principal Arterials	279.0	2.5	203.9	136
Minor Arterials	201.7	1.4	147.2	50
Collectors	89.5	0.6	65.0	130
All Urban Systems	884.1	10.0	548.8	75
All Systems	1,527.5	23.1	878.3	43

SOURCE: Congressional Budget Office, based on data from the Federal Highway Administration.

a. Includes capital disbursements for reconstruction, major widening, 3R (restoration, resurfacing, or rehabilitation), bridge rehabilitation and replacement, safety construction, and other rehabilitation. Thus it includes all capital disbursements except those for new construction.

b. Includes costs for vehicle operation, accidents, and property damage, as well as estimates for the costs of time spent during travel.

c. Based on a 10-year life for the rehabilitation and reconstruction projects.

As can be seen from Table 2, the rates of return on highway maintenance varied considerably among the different highways, and, in the case of rural Interstates, the returns were negative. Capital maintenance generally yields a much greater return on urban highway systems than on rural systems--75 percent compared with 16 percent--although returns for rural minor arterials and collectors (roads linking the main county centers to arterial highways) compare favorably with those on urban roads. The negative returns for the rural Interstates, and relatively low returns for other rural principal arterial roads, are explained by the very high costs for engineering work on them and the excess capacity available on these routes. While together accounting for only 17 percent of the rural federal-aid system mileage, and 12 percent of rural highway traffic, these main intercity highways receive half of the national rehabilitation budget for rural highways. In other words, more spending by counties and less by states for rural highway rehabilitation would increase the total payoff from highway spending.

Who Pays? Another issue in highway maintenance costs is whether users pay their fair share. In general, they do not. First, federal taxes undercharge heavy trucks for the damage they do to roads. Second, general revenues are increasingly being used to finance highway spending in place of taxes on highway users. Both of these underpayments are incentives to increased use of the roads, adding to public maintenance budgets and to operating costs for road users in general.

Fuel and other highway taxes are easy to collect--even very high rates for these taxes, as in Europe, seem to affect traffic levels very little--and the amount to be paid varies roughly with distance traveled, so that those who use highways the most pay more. But payments based on use do not vary closely with pavement damage. Road damage increases exponentially with the weight per axle of a vehicle. Given the mix of truck configurations in use, this means that the road damage caused by the largest trucks can be as high as 16 times that from smaller trucks, although the federal taxes levied range only up to six times higher. This means that all trucks above about 65,000 registered gross tons underpay. In 1982 and 1984, truck taxes were realigned to increase payments from heavy truck users, but the recovery rate for combination trucks remains at around three-quarters of the cost of the highway damage they cause. By the same token, some smaller vehicles overpay compared with the costs of their

road damage, while arithmetically, of course, all user groups other than heavy trucks must overpay slightly in relation to their fair shares of the tax burden.

Since 1984, the FHWA has been studying weight-distance taxes that combine a weight-based fee with measures of highway use. Its report, due in 1988, is expected to show that weight-distance taxes for trucks would be administratively feasible at reasonable cost, and a great deal fairer than the current mix of taxes.[6] Eleven states have weight-distance taxes: Arizona, Arkansas, Colorado, Idaho, Kentucky, New York, New Mexico, Nevada, Ohio, Oregon, and Wyoming.

Another source of highway funding is general revenues. Cumulatively, since 1957, the highway account has collected $191 billion in taxes and disbursed $195 billion for highway programs. But an additional $3.2 billion has been spent from general revenues on other highway programs, 70 percent of it in the 1980s.

The importance of highway spending outside the trust fund can be seen in Table 3. Had all federal highway spending since 1957 been charged to the Highway Trust Fund, its cash balance, which has remained at around $9 billion to $10 billion during the 1980s, would have been only slightly more than $1 billion at the beginning of 1988. At current levels of spending, the fund itself would require added revenue by 1990.

The importance of general tax sources becomes even greater when the activities of state and local governments are taken into account. Federal Highway Administration data show that in 1957, tax collections from highway users totaled $6.5 billion, or 73 percent of the $8.8 billion spent on highways by all levels of government; in 1987, these dedicated taxes covered only 65 percent of national highway budgets. State and local governments have been paying the difference out of their general funds. If the highway account were accumulating cash, this would represent a subsidy from state and local taxpayers to the federal government, rather than an excess of payments by highway users.

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6. Federal Highway Administration, *Feasibility of a National Weight-Distance Tax* (forthcoming).

THE OUTLOOK

In coming years, the national highway system will face a growing need for rehabilitation programs, but a much reduced need for new construction. New highways will be largely confined to rapidly devel-

TABLE 3. ALTERNATIVE ESTIMATES OF FEDERAL HIGHWAY TAXES AND SPENDING (In billions of dollars)

		Actual Trust Fund			Trust Fund and Other Federal Highway Programs			
Fiscal Year	User Taxes	Highway Trust Fund Outlays	Interest (Actual)	Balance (Actual)	Federal Fund Outlays	All Outlays	Interest (Reesti-mate)	Balance (Reesti-mate)[a]
				Actual				
1957-1959	5.6	5.1	b	0.5	0.6	5.7	b	(0.1)
1960-1969	36.1	35.3	0.2	1.5	0.1	35.4	b	0.7
1970-1979	62.2	55.6	4.5	12.6	0.3	56.9	3.7	10.6
1980	6.6	9.2	1.0	11.0	0.3	9.5	0.8	8.6
1981	6.3	9.2	1.1	9.3	0.2	9.4	0.8	6.3
1982	6.7	8.0	1.1	9.0	0.2	8.2	0.7	5.5
1983	7.8	8.8	1.1	9.1	0.3	9.1	0.6	4.8
1984	10.5	10.4	1.0	10.2	0.4	10.8	0.5	5.1
1985	11.6	12.8	1.3	10.4	0.3	13.1	0.6	4.2
1986	12.3	14.2	1.1	9.5	0.2	14.4	0.3	2.4
1987	11.8	12.8	0.9	9.4	0.2	13.0	0.2	1.4
1988 (est.)	13.0	13.5	0.8	9.8	0.2	13.6	0.1	0.9
1980-1988	86.6	98.9	9.5	9.8	2.3	101.1	4.7	0.9
1957-1988	190.6	194.9	14.1	9.8	3.2	198.1	8.4	0.9
				Projected				
1989	13.2	13.5	0.9	10.4	0.2	13.7	0.1	0.4
1990	13.3	13.9	0.9	10.7	0.2	14.1	b	(0.3)
1991	13.6	14.5	0.9	10.6	0.2	14.7	0.0	(1.4)
1992	13.8	14.8	0.8	10.5	0.2	15.0	0.0	(2.5)
1993	14.0	15.3	0.8	10.0	0.2	15.4	0.0	(4.0)
1989-1993	67.9	72.0	4.3	10.0	0.8	72.8	0.1	(4.0)

SOURCE: Congressional Budget Office, based on budget data and data from the Federal Highway Administration.

a. Balances in parentheses are negative. In practice, trust fund accounting would require additional revenue (from taxes or transfers of federal funds) or spending cuts to avoid negative balances.

b. Less than $50 million.

oping regions, or to those areas with severe urban traffic congestion. The growing rehabilitation needs will spring from the ordinary capital cycles of highways, and the increasing age of the network. Overall spending for highways, and the mix of construction and rehabilitation, will vary considerably among regions.

The rising rehabilitation needs do not indicate a lack of routine highway maintenance in the past. A 1986 CBO study found that in the early 1980s well over 80 percent of federal-aid mileage was in fair condition or better; a figure of just under 50 percent would have been expected for highways of similar age receiving only routine maintenance.[7] Since then, highway conditions have improved on the whole. But highways tend to remain in near-new condition for much of their useful lives and then to deteriorate rapidly from the cumulative effects of age and traffic damage. Major maintenance--4R work--tends to follow the same lumpy pattern as construction, with a 15- to 20-year lag. Current spending levels do not reflect the prospective changes in highway conditions, and hence offer no guidance for future spending.

Maintenance Strategies

The question of how much to spend on highways has many answers. Taking maintenance first, the Federal Highway Administration's 1987 report discusses strategies ranging from a continuation of current spending, costing around $12 billion to $13 billion a year in 1985 prices, to a program for fixing all deficiencies that would cost $33 billion to $36 billion a year.[8] Any of these strategies would provide a high rate of return on investment (in terms of user cost savings, as discussed earlier). But the estimated rates of return decline as investment increases. Table 4 shows estimated rates of return on each of five maintenance strategies, and the incremental returns for increasing spending levels. These estimates indicate that national economic benefits from highway maintenance could be increased by raising highway budgets above current levels and improving all highways to minimum standards. At the extreme, however, the extra cost of fixing

7. Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986).

8. Federal Highway Administration, *Status of the Nation's Highways.*

all engineering deficiencies in highways would exceed the consequent reductions in transportation costs.

These results follow from the patterns of the incremental returns to investment. First, maintaining real 1985 spending rates of just over $13 billion a year through the year 2000 (nationally, on all 4R projects) would clearly be a good investment. The spending, which would cumulate (after allowing for traffic growth) to $250 billion to $264 billion over the 16-year period, would reduce transport costs by an estimated $255 per thousand vehicle miles of travel; this reduction would provide a 39 percent return on the investment, which is comparable with the returns measured earlier for actual 4R spending during 1984 and 1985. Expanding spending to maintain current highway conditions would also provide high returns: additional transportation savings of $61 per thousand vehicle miles of travel or an incremental return of 33 percent to 40 percent, depending on traffic growth rates.

A glance at the next two strategies--maintaining current user costs or achieving minimum standards--shows the importance of targeting. Both would require similar expansions of investment from the "maintain current condition" strategy--that is, they would require extra spending of about $9 billion to $11 billion a year, cumulating over 16 years to outlays of $450 billion to $550 billion. Even if current highway conditions are maintained, transportation costs are still expected to rise above current levels--because of congestion, for example. But extra spending focused on maintaining current user costs (that is, on those improvements that would actually restore transportation costs to current levels) would provide a poor return of only 1 percent, while directing the spending to upgrading substandard segments to minimum standards (which would reduce costs below current levels) would provide a return in the range of 3 percent to 7 percent on the investment. While the latter return would be less than the spectacular returns of the first two strategies, it would exceed the expected federal cost of borrowing (adjusted for inflation).

The difference in returns from the latter two strategies can easily be explained: spending to maintain current user costs would direct extra spending to improving relatively good stretches of road, while not touching the substandard segments that do not meet current

TABLE 4. PROSPECTIVE RETURNS ON INVESTMENT FOR FIVE HIGHWAY MAINTENANCE STRATEGIES, UNDER LOW AND HIGH TRAFFIC GROWTH (Using 1985 prices)

Maintenance Strategy	Investment Cost, 1985-2000 (In billions of dollars)[a] Cumulative	Per Year	User Savings Per 1,000 Vehicle Miles[b]	Return on Investment (Percent)
Low Traffic Growth (2.15 percent growth a year in vehicle miles)				
Maintain Current Spending	250	13	255	38
Maintain Current Highway Conditions	279	15	316	38
Maintain Current User Cost Levels	446	24	344	30
Achieve Minimum Standards	497	26	357	28
Fix All Deficiencies	617	33	360	25
High Traffic Growth (2.85 percent growth a year in vehicle miles)				
Maintain Current Spending	264	13	255	39
Maintain Current Highway Conditions	315	16	316	38
Maintain Current User Cost Levels	498	25	355	30
Achieve Minimum Standards	546	27	365	29
Fix All Deficiencies	708	36	370	25

SOURCE: Congressional Budget Office, based on data in Federal Highway Administration, *The Status of the Nation's Highways: Conditions and Performance* (June 1987).

a. Investment costs are assumed to increase in proportion to traffic growth, under each strategy. The per year costs shown are for 1985, the first year of investment under each strategy.

(Continued)

standards; spending to achieve minimum standards, on the other hand, would direct the extra resources to improving conditions on those high-cost segments that do not meet current standards. In addition, as shown in a study by the Transportation Research Board, incorporating safety improvements in 3R projects in rural high-traffic areas can have a high payoff in reduced accident rates and reduced severity of accidents.[9]

9. Transportation Research Board, *Designing Safer Roads, Practices for Resurfacing, Restoration and Rehabilitation*, Special Report 214 (Washington, D.C.: The Board, 1987).

TABLE 4. Continued

Maintenance Strategy	Incremental Investment and Savings Above Previous Strategy: Investment Per Year	Incremental Investment and Savings Above Previous Strategy: User Savings Per 1,000 Vehicle Miles	Incremental Return for Increasing Investment (Percent)
Low Traffic Growth (2.15 percent growth a year in vehicle miles)			
Maintain Current Spending	13	255	38
Maintain Current Highway Conditions	2	61	40
Maintain Current User Cost Levels	9	28	1
Achieve Minimum Standards	11 [c]	41 [c]	3
Fix All Deficiencies	7	3	-4
High Traffic Growth (2.85 percent growth a year in vehicle miles)			
Maintain Current Spending	13	255	39
Maintain Current Highway Conditions	3	61	33
Maintain Current User Cost Levels	9	39	1
Achieve Minimum Standards	11 [c]	49 [c]	7
Fix All Deficiencies	9	5	-80

b. Savings in this column show savings in 2000 when compared with the trend in transport costs that would follow from deteriorating road conditions under a "No Maintenance" strategy.

c. Incremental investment and transport cost savings for this strategy are measured from the "Maintain Current Conditions" strategy, and not from "Maintain Current User Cost Levels."

Finally, extending investment further by the extra $7 billion to $9 billion a year needed to fix all deficiencies would have a negative return--that is, the benefits for users would be less than the costs of the improvements.

Building New Highways

Returns to new construction can be expected to show similarly variable results. A previous CBO report estimated that closing the gaps in the Interstate system would yield returns of 5 percent or less on over

40 percent of the projects (measured by cost), but would be well over 12 percent for nearly 35 percent of the projects, as of 1984.[10] Similarly detailed estimates cannot be made for other highway systems without a list of candidate projects. In general, prospective returns on new construction in urban areas, particularly on projects to relieve existing traffic congestion, can be expected to be higher than on those providing new intercity connections to the Interstate network, simply because of differences in unused road capacity in the two cases.

Returns on construction projects in general (which benefit relatively little traffic) can be expected to be lower than returns on the "maintain current conditions" maintenance strategy (which benefits all highway users).[11] A broad estimate for capacity-related improvements in urban areas, for example, shows expected returns on investment of around 9 percent to 15 percent, compared with the 40 percent estimate for maintaining current conditions. In determining priorities for overcoming urban traffic congestion, however, other alternatives should be compared with highway construction--such as transit development or land use adjustments, or noninvestment solutions including traffic management, opening bus lanes to all high-occupancy vehicles, and road pricing through tolls.

Construction of new urban highways may often be the only practicable solution to mounting urban traffic congestion because of difficulties in working out a consensus among the different jurisdictions in an urban area as to an alternative strategy that would reduce traffic bottlenecks without new highway construction. Road pricing, for example, though in theory a promising method of managing urban road capacity, has been successful in only one case--in Singapore.[12] Experiments sponsored by the Urban Mass Transportation Administration during the late 1970s sought to replicate the Singapore scheme in Berkeley, Honolulu, and Madison, but the attempts were aborted by political and institutional difficulties. A more comprehensive road-pricing system for Hong Kong, using transponders fitted

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10. Congressional Budget Office, *Federal Policies for Infrastructure Management*.

11. On the other hand, some construction projects may offer higher returns than the additional spending needed to achieve minimum standards on all federal-aid highway segments.

12. A comprehensive review of road pricing experience and research is given in Kenneth Button, ed., "Road Pricing," *Transportation Research*, Special Issue, vol. 20A, no. 2 (March 1986).

to autos in conjunction with recording devices built into the roads, similarly came apart when the government, in preparation for the colony's change in status in 1999, set up local governments that individually seceded from the scheme. The congestion-reducing effects of such a system had been successfully demonstrated in an experimental phase between 1983 and 1985.

Simpler forms of pricing, such as tolls on congested roads, also have promise for reducing congestion, but raise problems when drivers seek to avoid the tolls by using free roads that were previously uncongested. Federal policy now prohibits tolling of existing roads that have been constructed with federal aid, although nine pilot toll-highway construction projects have been authorized.

Broad economic priorities for highway investment can be based on the prospective rates of return already discussed. Table 5 compares these rates with the projected cost of federal, municipal, and business borrowing (net of inflation), shown in italics. While a clear case can be made for investing to maintain the current condition of the main highway network, a similarly strong and broad case cannot be made for higher levels of spending. Projects aimed at achieving minimum service or safety conditions, and those for new urban highway construction, appear to offer good economic returns but at rates that are likely to be matched by other investment opportunities in both government and business. Moreover, highway spending competes for resources with social programs that can have payoffs equally high or higher. In the final analysis, how much to spend will depend on decisions as to the relative importance of highways among all government programs, and beyond that on what part the government ought to play in investing the nation's capital.

POLICY OPTIONS FOR THE FEDERAL HIGHWAY PROGRAM

The completion of the national highway program begun in 1956 has created an opportunity to reexamine the federal role. There is reason to believe that the states now have strong incentives to undertake beneficial highway investments without skimping, and that economic savings resulting from highway improvements could provide a basis

for raising taxes to pay for them. The federal government could therefore withdraw from financing highways.

Some room for a federal presence may remain, however. Broad national economic priorities will not be felt equally in all states or regions (in particular, urban congestion will tend to outweigh system maintenance in some regions). Also, even when acting together, states may fail to be effective at some highway operations such as setting or enforcing nationwide safety standards for vehicles and driv-

TABLE 5. ECONOMIC PRIORITIES FOR HIGHWAY INVESTMENT

Investment Strategy	Expected Real Rate of Return on Investment (National averages)
4R Projects to Maintain Current Highway Conditions (Average Present Serviceability Rating of 3.1)[a]	30 percent to 40 percent
New Construction, Urban Areas	10 percent to 20 percent
4R Projects to Upgrade Sections Not Meeting Minimum Service or Safety Standards	3 percent to 7 percent
Projected 1993 Federal, State, and Private 10-Year Borrowing Rate	*3 percent to 4 percent*
New Construction, Rural Areas	Low[b]
4R Projects to Fix All Deficiencies Above Minimum Service and Safety Standards	Negative

SOURCE: Congressional Budget Office, based on data from the Federal Highway Administration.

NOTE: 4R projects are those involving restoration, resurfacing, rehabilitation, or reconstruction.

a. Present serviceability ratings rate highway conditions on a scale from 0 (very bad) to 5 (excellent). A rating of 3.1 puts the Federal Aid System in good to very good condition.

b. Economic returns may be higher for replacement of substandard bridges on the national truck network.

ers, or maintaining a national highway network. Moreover, targeting expenditures toward particular programs has become more important than formerly. Based on some feasible level of federal highway taxation, the government could help to focus maintenance on the national network and on priority tasks. To this end, the conditions attached to federal aid might be more important than the level of spending.

Withdraw From Federal Participation in Highway Development

Federal leadership in highway engineering may have seen its day. In recent years, particularly since 1983, states and localities, which have traditionally been responsible for most highway maintenance, have evolved systems for programming maintenance budgets that have shown overall good results. The American Association of State Highway and Transportation Officials has developed engineering standards for highways, and its research on highway issues is internationally respected. The association may be as effective at national leadership in highway engineering as the Federal Highway Administration.

In financing, as well as engineering, the federal role may be declining. Critics cite the instability of federal aid, as seen in the extended budget and legislative negotiations of recent years. An increasingly common view is that the federal government has become little more than a clearinghouse for receiving and disbursing dedicated highway taxes. Although this view ignores the extent to which highway spending is still financed directly and indirectly from federal funds, it reflects the idea that technical leadership may now have passed from construction to maintenance management and therefore to the states.

A further argument for federal withdrawal is that, according to econometric studies, federal aid no longer adds to states' spending on highway programs but only substitutes for state financing.[13] This finding reflects the strong local benefits of highway improvements: 10 years ago, a Federal Highway Administration report estimated that

13. These studies are reviewed in Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986).

40 percent of the gaps in Interstate mileage, and 73 percent of the remaining outlays for Interstate construction, were of purely local importance.[14] Given the local benefits, according to this view, states would be likely to replace lost federal financing from their own resources, both on the Interstate network and on other main roads. Interstate highways, after all, are not federal highways operated by the states but state highways that carry more traffic per mile than most other state roads. If the Primary highways can be safely entrusted to state management, runs the argument, so can the Interstates.

On the negative side, a federal withdrawal from highway financing would mean a shift in the distribution of tax revenues. The federal highway program tends to redistribute tax revenue from states with a lot of traffic to states with a lot of roads. This redistribution would disappear if states collected all of the highway taxes. Whether the shift would introduce inefficiencies is unclear. Under state financing, the states with the highest revenue per mile (because of highest traffic) would also tend to be those with the highest maintenance needs per mile. Nevertheless, some states with lower revenue potential have large highway structures to maintain, often constructed to conform with national standards rather than to reflect the needs of local traffic.

A further issue to be faced in a federal withdrawal would be the future of the Federal Highway Administration. Over the years, the FHWA has become expert both in highway engineering and in the management of national highway programs. Much of its engineering expertise could be absorbed by state or local highway agencies, and by the National Highway Traffic Safety Administration. But in its national management role it would still be valuable as an adviser to the Congress and to other jurisdictions, and it might also be of technical assistance to state and local agencies. For example, the FHWA's national monitoring system for highway performance was developed to provide information on highway conditions and needs to the Congress, and it is also used in some states for working out highway budgets. The FHWA's national bridge inspection program provides similar leadership in setting priorities for bridge rehabilitation and

14. Federal Highway Administration, *Interstate Gap Study*, Report of the Secretary of Transportation to the United States Congress (1977).

replacement. Under a withdrawal strategy, FHWA's role would probably evolve from an engineering-oriented perspective to one of policy analysis and technical assistance.

A real difficulty with a federal withdrawal is that state program priorities are not likely to match the national economic priorities sketched earlier. Even under federal aid, for example, states spend more on rural highways, and counties less, than would be optimum from a national point of view. Moreover, states can be expected to be more interested in intrastate commerce than in interstate commerce when determining which routes to improve. Some may attempt to tax out-of-state drivers more than their own residents. Finally, political support is often more easily won for impressive construction projects than for maintenance.

Continue Targeted Federal Aid

If federal highway assistance was continued after completion of the Interstate system, it could focus highway development on activities of national benefit. This would require a program that was highly structured, but not necessarily more structured than the 1956 Federal Aid Highway Act that focused most highway spending for the following 30 years. The 1956 act generated such a high degree of support that 95 percent of the construction on Interstate highways was completed or under way within 10 years. A plan for the 1990s, focused on rehabilitation rather than construction, would need a similar degree of support.

The scope of continued federal aid would be of concern. Some people argue that federal financing in the 1990s should be restricted to routes of national significance, and others that only the Interstates should remain a federal priority. (Routes of national significance might include those most important to interstate commerce--the national truck network, for example--and/or to national defense.) An appraisal of the present and future functions of different parts of the highway system might be necessary in order to determine which routes are of such national significance as to justify federal financing.

Alternatively, federal aid could be regarded as a subsidy to ensure that nationally beneficial projects would be undertaken, whatever the

network. Priorities for highway improvements vary considerably among states and regions. Also, budget allocations are affected by state and county custodianship of different parts of the networks, and such divisions may work to continue the present underfunding of rural county roads. Federal subsidies applied to projects of economic merit could help to move them up the funding ladder.

Federal aid should focus spending on priority areas, but also be flexible in dealing with regional variations. Two techniques for achieving this are tranching and negotiation. Tranching means dividing aid into several portions, each to be made available when certain conditions are met. Negotiating means allowing state and federal officials to bargain on the share or amount of aid for particular parts of the program, according to local needs and federal interests.

Tranching Aid. Separating aid into tranches would allow federal assistance to be divided among different purposes in amounts reflecting overall federal interests, and at the same time allow states that had already met federal standards for one purpose to trade aid from one tranche to another. They would thus have freedom to vary, within limits, the uses to which they put federal aid, while protecting the overall federal purposes of the program. An example of tranching is shown in the accompanying Box.

The federal share of costs under tranching would be determined by the level of highway taxes federal policymakers were willing to apply to the program. Since the total spent in any state would reflect agreed-upon criteria for maintaining highways (rather than the amount needed to match federal aid), the effective federal share of highway budgets could well vary from state to state.

Federal aid for individual projects should probably be less than the 75 percent to 90 percent range of current programs. Highways play a certain and central part in modern life, and the federal government may no longer have any reason to assume a disproportionate share of the risks of their development. On the other hand, it might be desirable to allow states to vary the federal shares from project to project or from tranche to tranche. For example, some states might want high matches on costly construction to avoid short-term increases in state tax rates, while others might want to spread assist-

BOX 1.
AN EXAMPLE OF TRANCHING

The following example illustrates the principles of tranching aid. Tranches, or portions of federal assistance, could be reserved for different types of projects:

Tranche A (70 percent)	For 4R projects for highways and bridges on the 1990 federal-aid system
Tranche B (15 percent)	For projects to remove safety hazards or to upgrade existing highways to minimum standards
Tranche C (15 percent)	For new construction

States would be required to budget sufficient resources (including federal aid) to meet some basic objective, such as maintaining conditions on the basic network at the base-year standard. Some standard, such as the Present Serviceability Ratings used by FHWA could be used to specify these conditions. Overall state budgets would be set independently of the federal-aid apportionments. Federal apportionments could be according to a formula reflecting prospective maintenance needs--considering both traffic and highway conditions, as well as miles and area served. Those states for which highway needs fell into the 70-15-15 pattern could go ahead and spend the federal money. Those with more than 70 percent 4R needs or more than 15 percent in either of the other categories could trade aid among categories according to set conditions. For example:

Trade	Condition
From A to B	All federal-aid highways to be in fair or better condition (present serviceability rating 2.5 or better); and the average condition to be not less than in the base year
From A or B to C	As above, plus all federal-aid highways to meet minimum standards
From C to A or B	No condition

These illustrative conditions would establish a clear preference for system maintenance or upgrading the existing network. Yet all states would receive some assistance for new construction, and those with fairly sparsely traveled rural highways in good condition would be able to trade in aid to help solve urban congestion. Those with high urban and rural highway needs might have to increase resources from their own tax bases (as they would under a simple continuation of the current program). In this illustration, the measures of highway condition affect both apportionments and trade-ins, so states have no particular incentives to over- or underreport. States that underreported highway conditions would receive larger apportionments but would have less flexibility in spending them; states overreporting could spend federal aid relatively freely but would receive less of it.

ance widely over all projects. Tranching could allow states some discretion on matches by allowing federal cost shares of up to some share, say 50 percent, for projects in each tranche.

Tranching would give states the advantage of managing their own highway budgets, subject to meeting agreed-upon performance targets. Since state governments are closer to local needs, they may be able to assign aid more effectively under existing priorities than can any broad-based federal allocation formula. On the other hand, states have different interests from the federal government, and might be tempted to turn the program to their own advantage. Safeguards against this would be provided by states' agreement to the minimum condition rating, and by their preparation of budgets conforming with overall maintenance needs.

Negotiating Aid. Within broad parameters set by federal policy, negotiating aid could have many of the advantages of tranching, and answer some of the concerns about whether states would achieve federal performance levels. Federal and state representatives could negotiate agreements covering the amounts to be spent for maintenance and rehabilitation and for new construction; the parts of the highway system where aid would be spent; overall state maintenance targets and budgets; and federal project matching shares. The time period could be that of the authorized federal program, or any shorter period. Subsequent negotiations would take note of a state's actual performance compared with negotiated targets, and adjust penalties and incentives appropriately.

Under negotiated aid, states could attempt to match both the amount and the conditions of aid to their circumstances, while federal negotiators would attempt to move state budgets and policies more into line with federal interests. Federal agents could, for example, offer easier terms for maintenance aid in states where federal-aid networks were in generally worse condition than other states, or they could seek to get states to enlarge their maintenance budgets in exchange for construction aid.

Negotiating would therefore tend to distribute aid more closely in line with national needs than formula distributions could. It would also avoid setting arbitrary aid conditions that some states might have difficulty meeting, since each state would agree to the package of

aid and conditions. As with tranching, the overall level of federal assistance could be set by a decision by policymakers on the rate of federal highway taxes, reflecting a judgment as to how much assistance would be needed to exert federal influence on priority choices for highways.

Negotiating aid would leave highway assistance much more open to manipulation than would tranching. Also, the administrative effort would be much greater than that needed for formula or even tranche apportionments. States not wishing to comply with agreements might tend to seek legislated relief from the terms of their federal-aid contracts, or might simply ignore some of the terms knowing that federal agents would have difficulty enforcing penalties. Federal negotiators, for their part, might (as has happened in the past) seek performance conditions couched in terms that would be easy to verify but that would be unnecessarily expensive--such as maintenance standards that reflect engineering excellence rather than good average performance of the highway system and good levels of service to users. Any transition to negotiated aid would have to be managed closely, with a view to applying the lessons in future negotiations.

CHAPTER II

MASS TRANSIT

Despite more than 25 years of federal assistance, mass transit carries only about 5 percent of people who commute to work. The other 95 percent mostly use automobiles, although more than one-fifth of them share rides in carpools or vanpools. New federally assisted transit systems have not added to mass transit; instead, they have replaced flexible bus routes with costly fixed-route services to a few downtown areas, while the growth in jobs and population has been in the suburbs and in smaller cities. At the same time, transit costs are rising: transit fleets in general are greatly underused, and the new transit systems have for the most part added to costs and to unused capacity without attracting riders from cars. Transit remains important in the older and larger cities where it carries upward of 25 percent of commuters, and public transportation services are disproportionately important to the poor, the old, the young, and the disabled. Special transit services for elderly and handicapped riders are increasingly expensive and polluting, and do not meet the needs of those in the community who depend most on public transportation.

THE CHANGING FEDERAL ROLE IN MASS TRANSIT

Federal financial assistance for mass transit began in 1961 when the Department of Housing and Urban Development initiated a small program for transit demonstration projects and loans. The current program--and the Urban Mass Transportation Administration (UMTA)--date from the Urban Mass Transportation Act of 1964. This act spelled out a federal purpose of modernizing transit and also reestablishing it in 105 cities that lost service between the mid-1950s and the mid-1960s.

Twenty-five years ago, federal intervention was felt to be needed to avert widespread abandonment of transit services in the central areas of older cities. Testimony at Congressional hearings on the 1964

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act emphasized the effects on urban development and congestion that would follow from a continued decline of mass transit. Estimates were presented that, if commuter rail services were abandoned in Boston, Chicago, Cleveland, Philadelphia, and New York, the highways needed to replace them would cost $31 billion. In Chicago, for example, 600,000 more automobiles, 160 new expressway lanes, and extensive parking areas would be needed. Nationwide, costs were cited of $5 billion a year for lost time, fuel, and other consequences of traffic congestion.[1] The first priority of the Urban Mass Transit Administration in administering the transit capital grants program was to be "preservation of existing transit systems which would otherwise be abandoned," by modernizing rundown fleets and taking over failing private bus companies. Efforts to improve and extend transit services received only second- or third-level attention.[2]

All federal aid initially took the form of discretionary project financing. Modernization projects of states, localities, and their agencies were eligible for support if they were part of an areawide transportation plan. Within the total aid, separate financing tiers were set aside for bus and rail projects. The federal share was originally set at up to two-thirds of project costs (allowing UMTA some discretion in setting grant conditions), and raised to a mandatory 80 percent in 1973.

Federal aid broadened after 1970, when financing for highway transit (and urban highway) projects became available from the Highway Trust Fund under the Federal Aid Urban Systems program. Project financing remained discretionary, but it could include highway-related transit projects that provided bus lanes, traffic control devices, or passenger facilities to substitute for urban highway development projects of equivalent capacity. Beginning in 1971, federal aid was extended to assist the construction of new transit (mostly rapid rail) systems. Between 1973 and 1983, transit projects were able to use funds authorized for unbuilt segments of the Interstate highway

1. House Banking and Currency Committee, *The Urban Mass Transportation Act of 1964*, Report No. 204 to accompany H.R. 3881 (April 9, 1963).

2. George W. Hilton, *Federal Transit Subsidies: The Urban Mass Transportation Assistance Program*, American Enterprise Institute Evaluation Studies, No. 17 (Washington, D.C.: AEI, June 1974).

network, which were then withdrawn from the highway construction plan. The Rehabilitation Act of 1973 required that publicly financed transit systems be accessible to all, including the elderly and the disabled.

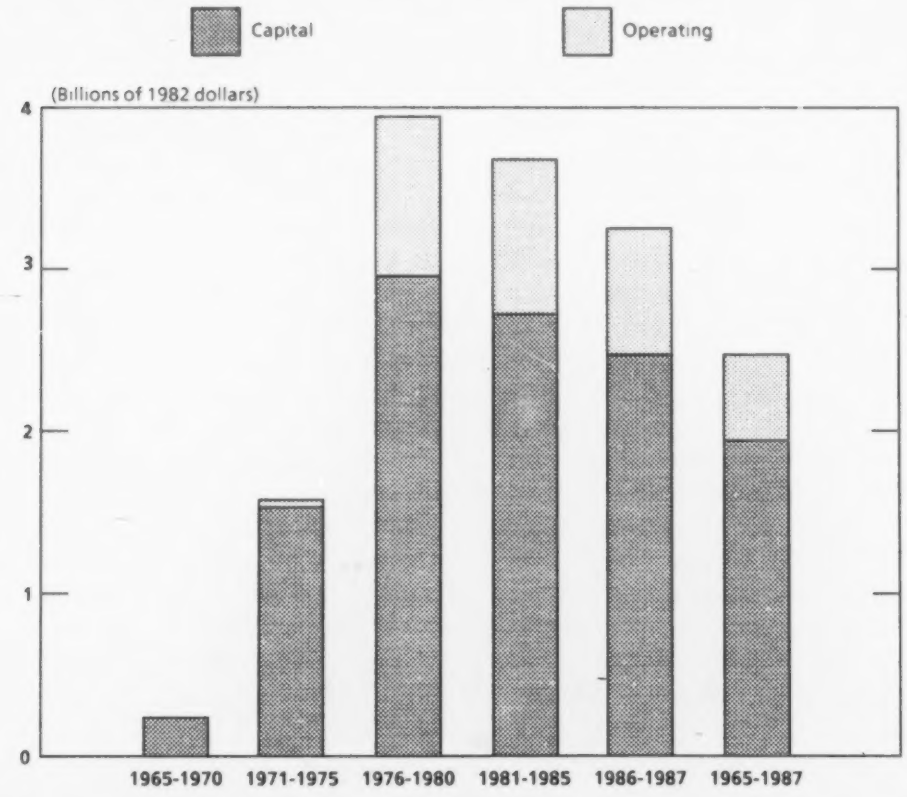
Federal formula grants for mass transit were authorized in 1974. These grants provided aid to urban areas nationwide based on population and population density, and extended aid to include operating subsidies for transit. Federal aid was available for capital grants at an 80 percent federal share, or for operating assistance at up to 50 percent of agencies' operating losses. During the late 1970s, over 80 percent of formula grants, on average, were used for operating assistance, and transit subsidies were seen as part of the national energy conservation effort.

The last major changes in transit assistance were made in 1982. In that year, a mass transit account was set up in the Highway Trust Fund, financed with revenues from a tax of one cent a gallon on fuels. The transit account finances discretionary (capital) projects, including bus and rail modernization and new starts, at a federal share of 75 percent of cost. Federal shares remain at 80 percent for capital grants and up to 50 percent for operations in the formula program, but a cap limits operating assistance. A new program established in 1982 provides aid for services in rural areas.

The late 1970s saw the highest levels of federal assistance for transit. Not coincidentally, this period was also one of great concern about foreign oil supplies, high fuel prices, and energy conservation. Overall, in real terms, federal aid to transit increased two and one-half times, from average annual levels of just over $1.5 billion in the 1971-1975 period to just under $4 billion a year in the 1976-1980 period (see Figure 2). Since the first half of the 1980s, however, average annual aid levels have fallen about one-eighth overall, with a steeper fall in operating aid (about a one-fifth drop) than in capital grants (down about one-tenth). Ninety percent of the drop in average capital grants arises from the tailing off of transit financing from Interstate transfers (trade-ins of unwanted Interstate highway segments). New obligations for transit aid in 1987 included $2.5 billion for capital grants and $860 million in operating subsidies, for a total of $3.4 billion.

More dramatic than the recent shifts in levels of aid, however, have been the changes in its distribution. Appropriations for capital aid are now fairly evenly divided between formula and discretionary (trust fund) programs (about $1 billion each), with an additional $400 million or so coming from older authorizations for Interstate transfers and from appropriations for the transit system in Washington, D.C. Over 40 percent of federal capital assistance is thus made available according to a broad formula based on population, population density, and transit performance levels. By contrast, in 1980 less than 15

Figure 2.
Average Annual Obligations of Federal Aid for Transit



SOURCE: Congressional Budget Office, based on data from the Urban Mass Transportation Administration.

percent of capital aid was available for such general assistance: about seven-eighths of all federal capital grants in 1980 went to specific projects approved either under discretionary programs or as Interstate transfers. While overall capital assistance is less now than in 1980, much more is available, on very general criteria, to medium and small cities, and relatively much less for major transit projects.

WHAT HAS BEEN ACCOMPLISHED?

Transit presents a confused picture. On the one hand, transit is important for commuters in older cities, and for the young, the old, and the poor. But nationally, transit systems suffer from declining patronage, underused facilities, and mounting deficits. Thus, assessing the transit program raises the following questions:

- Who uses transit? In modern American cities, what is the role of transit services?
- How well do transit agencies provide services? and
- Do federal aid programs focus on the right role?

Who Uses Transit?

Transit services are used mainly by commuters to downtown jobs and by those for whom autos are not as readily available as for the population at large. While commuters are 40 percent of transit riders, transit represents only 5 percent of national commuting. Nationally, almost 90 percent of Americans drive to work.[3] Commuter transit assumes more importance in the older and larger cities. According to the Nationwide Personal Transportation Study of 1983-1984, over 80 percent of public transportation use on journeys to work occurs in cities with a population of more than 1.25 million. Public transportation services bring a little more than 15 percent of people to work in

3. About 7 percent of workers walk to work, work at home, or are making an intercity trip on any business day. See Department of Transportation, *Personal Travel in the U.S., 1983-1984 Nationwide Personal Transportation Study* (November 1986).

cities with over 3 million people, compared with less than 1 percent in cities of under 250,000 people, and 3 percent to 5 percent in medium-sized cities. Census results for 1980 show that about 60 percent of New Yorkers rely on public transportation to get to work; 33 percent or more in Chicago, San Francisco, Washington, D.C., Boston, and Jersey City; and around 25 percent in older industrial cities like Baltimore, Hoboken, and Newark.[4]

Even in the cities, however, transit is important only for residents of central areas; suburban residents overwhelmingly use other means to commute and have been doing so increasingly. Table 6 shows how patterns of commuting changed between the 1970 and 1980 population censuses. In 1970, 30 percent of workers resident in the central areas of the largest 25 cities rode transit to work. (This includes the 34 percent who lived and worked in the central cities and the 14.8 percent who lived in the central cities and worked elsewhere.) In 1980, the proportion had fallen to 26 percent. Transit shares for all types of commute fell over the 10 years except for those traveling from the suburbs to downtown, where the percentage using transit increased very slightly. At the same time, the downtown areas themselves became less important as job centers. Downtown work trips dropped from 49 percent to 43 percent in the largest 25 cities, and from 58 percent to 56 percent overall. Of the 36 percent of workers who live and work in the suburbs--the fastest growing segment of the commuter market--only 2 percent (about half the rate of 1970) commute by transit.

Apart from downtown commuters, transit is of particular importance to children, teenagers, the elderly, those with low incomes, and women. The young and the elderly together represent nearly 40 percent of all transit riders. Workers with household incomes of less than $20,000 a year make up 44 percent of transit riders. Women use public transport for roughly one-fifth to one-third more of their trips than men do.

4. Bureau of the Census, *County and City Data Book 1983* (November 1983). Census data include both transit and taxi trips as public transportation.

How Well Do Transit Agencies Provide Services?

After 25 years of federal aid, transit agencies have modern fleets and many own considerably more vehicles than they need for rush-hour traffic. Yet most of the equipment in service is underused, and the federal operating subsidies go largely to pay for buses and trains running empty rather than for service improvements or fare discounts.

TABLE 6. WORK TRIPS AND TRANSIT USE IN 1970 AND 1980

Journey Type	Percent of All Work Trips		Percent of Work Trips by Transit	
	1970	1980	1970	1980
All Cities				
Within the Central City	42.6	37.2	17.3	15.7
From the Central City to All Other Places	10.5	8.6	9.6	5.4
From the Suburbs to the Central City	15.8	18.6	11.6	11.4
Within the Suburbs	31.0	35.7	4.1	2.0
All Journeys	100.0	100.0	13.0	9.1
Largest 25 Cities				
Within the Central City	33.9	26.7	34.0	29.7
From the Central City to All Other Places	8.3	6.2	14.8	9.2
From the Suburbs to the Central City	15.1	16.4	16.3	18.2
Within the Suburbs	35.1	41.5	4.8	2.4
Place of Work Not Reported	7.7	9.3	24.8	15.5
All Journeys	100.0	100.0	18.8	13.9

SOURCE: Joint Center for Political Studies, *Demographic Change and Worktrip Travel Trends*, prepared by Urban Mass Transportation Administration (February 1985).

TABLE 7. PERFORMANCE AND CONDITION OF TRANSIT FLEETS, 1985

Mode	National Fleet Total	Number of Transit Agencies	Annual Passenger Miles of Travel (In billions)	Typical Useful Life of Vehicles (In years)	Average Fleet Age (In years)
Commuter Rail					
Locomotives	420	12			18
Passenger Coaches	1,823	13	6.5	35	20
Other	2,212	6			13
Rapid Rail	9,326	11	10.4	35	17
Streetcars	797	8	0.3	20-30	21
Buses					
Articulated Buses	1,491	29			3
Class A Buses	46,548	315			8
Class B Buses	2,613	178	18.7	12-20	6
Class C Buses	1,926	195			5
Trolley Buses	676	10		15-20	8
Passenger Vans	2,427	155	0.1	7-15	4
Demand-Response Systems[d]	6,400	250	0.1	d	d

SOURCES: Congressional Budget Office based on data from Urban Mass Transportation Administration, *National Urban Mass Transportation Statistics 1985, Section 15 Annual Report* (August 1987); D. Dunoye and W. Diewald, *Trolley Bus and Motor Coach Operational Cost Comparisons Utilizing Section 15 Data* (Washington, D.C.: 67th Annual Meeting, Transportation Research Board); John C. Bennett, *Strategic Planning as a Basis for Capital Investment Programming: Case Study of the Regional Transportation Authority in Chicago* (Washington, D.C.: Transportation Research Board, January 1988); and Joint Center for Urban Mobility Research, *Revenue Forecasts for Innovative Light Rail Financing Options*, Denver Case Study, prepared for Urban Mass Transportation Administration (September 1983).

(Continued)

Modernization of transit systems has been more successful in bus than in rail fleets. As Table 7 shows, the average age of the bus fleet is broadly within its expected half-life, so that accelerated programs of modernization are no longer needed. But the national rail fleet is relatively older. For rapid rail this reflects the dominance of the New York area in rail systems; for commuter rail, aged fleets are more generally the rule.

TABLE 7. Continued

Mode	Percent of Active Fleet Used in Rush Hour	Passenger Load Factor (Percent)[a]	Cost per Passenger Mile (In cents)[b]	Average Fuel Efficiency (Btu per passenger mile)[c]
Commuter Rail				
Locomotives				
Passenger Coaches	85	28	60-70	2,500-5,000
Other				
Rapid Rail	79	12	120-180	3,000-5,000
Streetcars	67	18	320-360	4,000-6,000
Buses				
Articulated Buses				
Class A Buses				
Class B Buses	82	20	30-40	3,000-5,000
Class C Buses				
Trolley Buses			50-60	
Passenger Vans	91	96	10-15	1,200-1,800
Demand-Response Systems[d]	76	13	160-200	8,000-14,000

Continued

a. Passenger miles carried as a percentage of capacity miles operated.

b. Includes capital, operations, and maintenance.

c. Btu = British thermal units.

d. Vehicles used on demand-response systems are included in bus and van totals.

The overcapacity of existing transit fleets can be seen from two indicators in Table 7. First, only about 80 percent of the national bus fleet is regularly used in peak service. Nine out of 12 rapid rail transit agencies have fleets exceeding their peak requirements by 20 percent or more; only two-thirds of streetcars are used regularly in rush hours. Second, load factors--that is, the percentages of capacity miles of service used by passengers--are low, averaging less than 30 percent for

all major transit modes.[5] Load factors tend to be lower in transit than in other transportation services because of the heavy peaking of commuter traffic. But an average bus loading of 20 percent means that only one-fifth of the places available throughout the day are used by passengers. If buses are full in rush hour, they may be running lightly loaded or perhaps even empty during the rest of the day; and if they carry significant numbers of shoppers and others in nonrush hours, they may be lightly loaded at the peaks.

The only mode offering efficient use of agency fleets is vanpools, in which 91 percent of the fleet is regularly used and load factors (because vanpools rarely offer off-peak service) average 96 percent of capacity. Many more vanpools are organized privately than by transit agencies: in all states except New York and North and South Dakota, about one-fifth of workers take carpools or vanpools to work, making this form of shared transport the preferred national alternative to the drive-alone commute.

The low load factors are important for two reasons. First, they indicate overinvestment, or at least poor management of transit capital. Second, low load factors imply that there are too many buses on the roads; empty and lightly loaded buses may be adding to, rather than reducing, traffic congestion on the main corridors. Moreover, when assigned exclusive lanes, poorly patronized buses may actually reduce road capacity. Buses are two to three times more intrusive in traffic than cars or vans, and they are often assigned exclusive lanes to improve traffic flow. This may actually reduce road capacity if the busways are carrying fewer passengers than their equivalent in cars or vanpools. Opening busways to all high-occupancy vehicles may often be more effective in improving the use of road capacity, and reducing commuting times, than any transit investment.[6]

Vanpools are the cheapest form of public transportation. They are also the most fuel-efficient, and hence less polluting than buses. They

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5. The supply of transportation services is typically measured in terms of capacity miles, and demand for or use of services in passenger miles (ton miles for freight). A typical 35-seat transit bus has capacity (counting seats and standing room) for 65 to 70 passengers. Thus a bus traveling one mile supplies up to 70 capacity miles of service. If 30 passengers travel on that bus over the one-mile route, transit demand is 30 passenger miles, and the bus's load factor is 43 percent.

6. See, for example, John F. Kain, "Choosing the Wrong Technology: Or How to Spend Billions and Reduce Transit Use," *Journal of Advanced Transportation*, vol. 21 (Winter 1988).

carry an insignificant portion of the transit agencies' traffic, however. Next in order of cost is bus service, followed by trolley buses and then by the commuter services of railroads (which share their infrastructure cost with long-distance rail services). Demand-response services, used mostly by elderly and handicapped people, are the most expensive form of bus or van service. Essentially these services substitute 12-passenger vans for taxi service, since they operate on demand, but they average only two passengers per trip. Finally, rapid rail systems are three to five times more expensive per passenger mile than buses.

Is Federal Aid Funding the Right Projects?

Neither of the two forms of federal aid--the formula program and the discretionary program--seems to be tailored to the needs of present-day transit systems. Some cities receive more aid than they can use, while others are encouraged to undertake transit investments that will benefit only a fraction of their commuters. Cities with older rail systems, however, lag behind in modernization, although they carry more of the nation's transit passengers.

The Formula Program. The increased use of formula assistance under the 1982 Surface Transportation Assistance Act has shifted capital aid away from the main transit needs of the cities. Unobligated balances of appropriations and contract authority for transit aid increased from $663 million in 1982 to a peak of nearly $2 billion at the end of 1985, falling off by the end of 1987 to $1.7 billion. In 1985, more than $1 billion in unused formula funds was available to cities and rural centers. A study by the General Accounting Office at that time showed that about $707 million of this total was apportioned to cities of less than 1 million population with no transit projects to undertake.[7] Since 1985, lower Congressional appropriations for transit have helped to draw down the unobligated balances for formula assistance; by the end of 1987, they stood at a lower, though still substantial, $850 million.

One reason for the unused formula resources is that the urban formula program apportions aid--for all but the very largest cities--

7. General Accounting Office, *Budget Issues, Analysis of Unexpected Balances at Selected Civil Agencies* (September 1986).

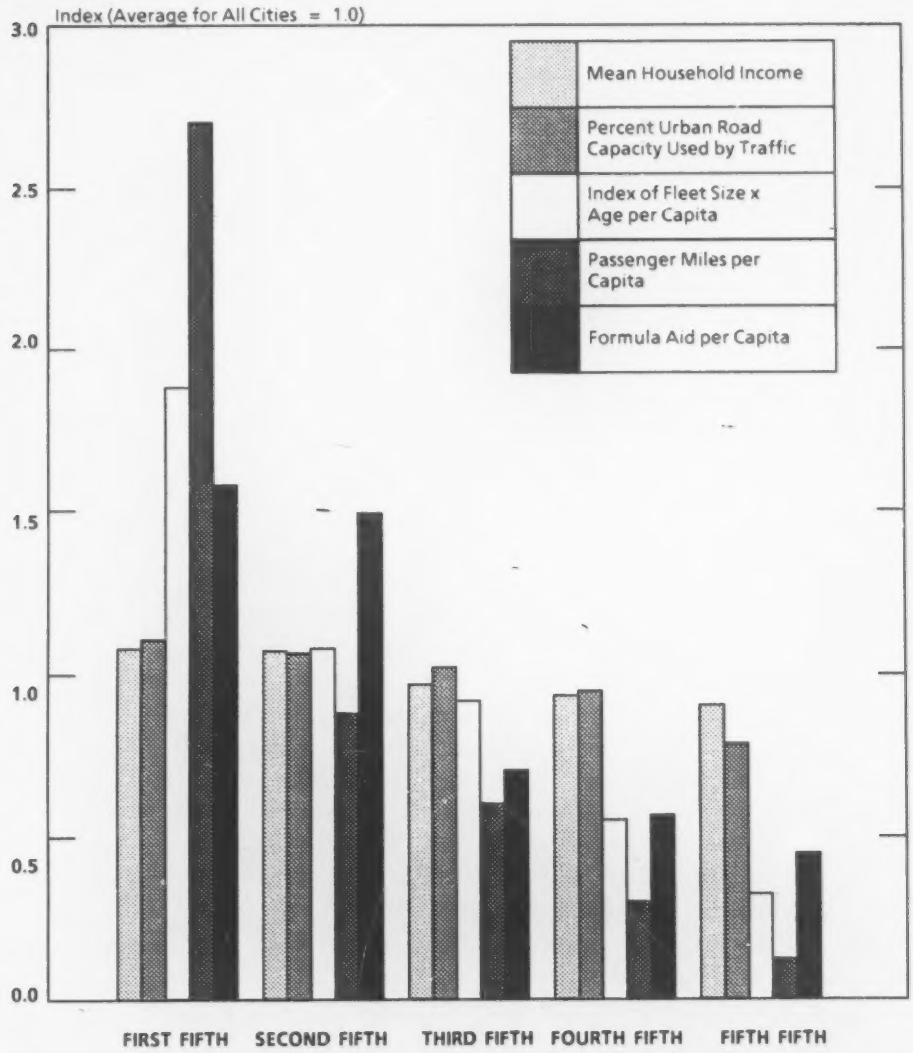
well in excess of reasonable indicators of need. Figure 3 compares indexes of transit aid with indexes reflecting apparent needs for investment or federal subsidies. The indexes are grouped in blocks, each representing one-fifth of the population in cities receiving federal aid for transit, arranged by city size. The first block shows data for the largest three cities (all with populations of 7 million or more) that together have 20 percent of the population in cities receiving transit aid under the urban formula; and the fifth block shows data for the smallest 244 cities (with populations ranging from 180,000 to 50,000). The bars show the average value of the variables in each block in relation to the average for all cities receiving aid. For example, mean household income in the largest cities is 10 percent above the average for all cities receiving aid (a plot point of 1.1), and passenger miles per capita in the largest cities is about 2.7 times the average for all aided cities.

As shown in the figure, formula aid per capita drops from 1.6 times the national average in the largest cities to half the national average in the smallest, for an overall ratio between highest and lowest of 3.2 to 1. But the need for transit investment declines even faster: as measured by a fleet index based on numbers of vehicles and their average ages, the need for investment drops from highest to lowest in the ratio of 6.3 to 1; and as measured by passenger miles per capita, the need for investment drops from highest to lowest in the ratio of 27 to 1.

Thus transportation requirements do not argue for giving relatively more transit assistance to small cities. Urban road congestion is about the same in all cities receiving transit aid. In the smaller cities, however, transit is an insignificant mode, and relieving the congestion depends on projects other than transit. The notion that federal "seed capital" for transit development in smaller cities could promote a solution to urban traffic snarls is not borne out by the demand for transit services. Moreover, variations in household income do not support such generous aid to small cities: median household income is only 20 percent lower in the smallest cities than in the largest, and is close to the national median of $23,000.

The formula apportionments reflect mostly the effects of the population and population density variables in the formulas. These variables were originally included in the formulas for lack of good data on

Figure 3.
Distribution of Formula Aid and Indicators of Transit Need, by City Size



SOURCE: Congressional Budget Office, based on data from the Urban Mass Transportation Administration, Federal Highway Administration, Bureau of the Census, and American Passenger Transit Association.

NOTE: The indexes are grouped in blocks, each representing one-fifth of the population in transit-aid cities, arranged by city size. The first block represents the fifth of the population in the largest cities, and the fifth block the fifth in the smallest cities.

TABLE 8. COMPARATIVE PERFORMANCE OF BUS AGENCIES, BY SIZE

Number of Buses Operated at Peak	Percentage of Fleet Used in Rush Hour	Passenger Load Factor (Percent)	Percentage of Revenue from Fares		Percentage of Revenue from Federal Aid	
			Bus-Only Operators	All Operators	Bus-Only Operators	All Operators
Fewer than 25	72	8	27	20	26	16
25 to 49	77	6	35	25	22	23
50 to 99	79	14	47	35	7	16
100 to 249	81	19	50	41	10	13
250 to 499	79	19	23	29	9	10
500 to 999	82	22	30	26	8	7
1,000 or more	86	28	27	41	11	6
All Agencies	82	19	34	37	11	8

SOURCE: Urban Mass Transportation Administration, *National Urban Mass Transportation Statistics, 1985, Section 15 Annual Report* (August 1987).

transit performance. But the population variables are a poor reflection of transit needs and use. Transit use is more closely tied to urban size than to population numbers, and the effects of density are ambiguous: high densities may have lower transit demand because travel distances are shorter in such areas, and low densities may also have lower demand because dispersed activities must often be more self-contained.

Smaller towns have sought to cope with their "excess" federal aid by converting as much of it as possible to operating subsidies. On average, the three largest cities that house the first one-fifth of the population in Figure 3 use 65 percent of their federal formula apportionments to finance capital projects, while the next largest 11 cities spend 72 percent of their available funds on investment. The smallest 244 cities use less than 40 percent of their formula aid for capital improvements.[8]

8. American Public Transit Association.

Smaller cities use more federal operating aid for two reasons. First, their operating costs are higher, since transit is relatively less efficient in smaller cities than in the larger centers. Table 8, above, shows that load factors in agencies with fewer than 50 buses average as low as 6 percent to 8 percent (that is, passenger miles traveled are only 6 percent and 8 percent of capacity), and that the percentages of fleets used in peak hours are markedly lower than in large agencies. Both of these conditions inflate operating costs. Second, smaller cities typically offer deeper fare discounts. The smallest transit agencies set fares at around 20 percent of costs, and small bus agencies at less than 30 percent, compared with a national average of 37 percent. Thus the relatively greater dependence of smaller cities on federal operating aid reflects largely local policy choices on fare subsidies, and poor management of federally subsidized capital assets.[9]

The Discretionary Program. New transit systems financed with federal aid--particularly rapid rail projects--have not lived up to their promise. Generally, they have lowered the efficiency of transit service by adding expensive unused capacity. For example, Washington, D.C., and Atlanta have greatly expanded their transit capacity, but six-sevenths of their capacity goes unused. Providing the unused service has been expensive: costs per passenger mile in Atlanta rose from an average of 28 cents (at 1985 prices) in 1980 to 86 cents in 1985, and in Washington, D.C., from 86 cents to $1.12 (see Table 9). In Miami, which also made a substantial rail investment with federal assistance, costs increased from 31 cents in 1980 to 71 cents in 1985.

For the most part, the new rapid rail systems took the place of existing bus service, but their failure to attract large numbers of new riders to fill the extra seats they offered stems chiefly from the effect of that switch on travel times and costs. To compete with autos, public transportation must be attractive in terms of convenience, time, and cost. The locations of routes, the frequency of service, and the fare are all important in attracting riders. The new rail systems may be less attractive to previous bus riders than the buses they replaced, and hence, as a corollary, are less likely to divert auto drivers to transit. Typical transit buses seat 40 to 45 riders, and can carry about 70 including standees. New rapid rail cars carry 200 to 220 riders, with

9. Small agencies in all transit modes look to federal subsidies for 20 percent of their operating costs, compared with a national average of 8 percent.

perhaps 6 cars to a train--or as many passengers as 15 to 20 buses. Some riders will find trains faster, cleaner, and more convenient than buses. But a single train will not offer the same total satisfaction as would 15 or 20 buses; riders from a much greater catchment area will find that faster rail trips are offset by longer times spent in making connections at either end. Even those who live or work conveniently to the stations may have to pay for faster travel by train with longer waiting times. In fact, much of the poor performance of the rail systems can be traced to the difficulties in managing capacity in large

TABLE 9. TRANSIT PERFORMANCE IN CITIES WITH NEW OR RECENTLY EXPANDED RAIL TRANSIT SYSTEMS

	Transit Performance, 1980[a]				Transit Performance, 1985[a]			
	Capacity Miles (Billions)	Passenger Miles (Billions)	Passenger Load Factor (Percent)	Cost per Passenger Mile (Cents)[b]	Capacity Miles (Billions)	Passenger Miles (Billions)	Passenger Load Factor (Percent)	Cost per Passenger Mile (Cents)
Atlanta	2.1	0.5	25	28	3.8	0.5	14	86
Baltimore	1.6	0.4	25	41	1.3	0.4	27	45
Cleveland	0.7	0.5	69	52	1.3	0.3	23	58
Miami	1.5	0.4	26	31	1.8	0.3	17	71
Pittsburgh	2.7	0.6	22	39	2.1	0.4	18	46
Washington, D.C.	6.4	1.2	18	86	8.0	1.2	15	112

SOURCE: Congressional Budget Office, based on data from the Urban Mass Transportation Administration and Table 7.

a. All cost estimates are in 1985 prices, and include capital replacement and operations and maintenance expenses. Operating costs in each city are based on statistics for each mode reported to UMTA, and estimates of capital cost at replacement value from sources in Table 7.

b. Calculated as follows: in Atlanta, for example, operating costs per capacity mile for motor buses are estimated at just under 6.9 cents and for rail at just under 17.1 cents. With a 1985 load factor of 17.4 percent on the buses, bus costs then average 39.4 cents a passenger mile (6.9 cents divided by 17.4 percent) and rail costs average $1.51 a passenger mile (.171/.113). Weighting each of these by the passenger miles on each mode gives a city average for 1985 of 86 cents a passenger mile.

(Continued)

train-load units while maintaining acceptable service routings and frequencies.

Had managers been able to hold load factors at 1980 levels, service costs in Atlanta would have risen to only 49 cents a passenger mile, or 60 percent of current levels (see Table 9). But this would have meant running the new rapid rail system at service intervals that would have led many riders to switch to auto travel, or else cutting fares sufficiently to induce a very large shift to transit use. Improved

TABLE 9. Continued

	Effect of Service Changes on Cost (Cents)				
	Overall Cost Increase per Passenger Mile	Estimated Cost at 1980 Load Factor, per Passenger Mile[c]	1985 Estimated All-Bus Cost per Passenger Mile[d]	1985 Revenue per Passenger Mile (Cents)	Estimated Percentage Reduction in Operating Subsidy for All-Bus System[e]
Atlanta	57	49	23	7	27
Baltimore	4	49	32	14	28
Cleveland	6	51	32	11	25
Miami	40	47	33	11	40
Pittsburgh	7	38	38	14	21
Washington, D.C.	26	103	23	15	75

c. Estimated by substituting the 1980 load factor for the 1985 load factor in the calculations of cost per passenger mile. In Atlanta, for example, cost per passenger mile at a 25 percent (1980) load factor is 26.6 cents for buses and 68.9 cents for rail. Bus and rail estimates are then combined into a city average by reestimating the split between bus and rail traffic at 1980 loadings.

d. Estimated by assuming all passengers are carried on the bus system. In Atlanta, for example, this would raise the load factor from 14 percent to almost 30 percent and lower costs per passenger mile to 23 cents.

e. Excludes allowances for capital replacement. In Atlanta, for example, operating costs per passenger mile (from data reported to UMTA) were 22 cents. Revenue per passenger mile was just under 7 cents. Thus the subsidy was 15 cents a passenger mile. Under these estimates, operating costs for an all-bus system in Atlanta would be about 18 cents a passenger mile. Therefore, an all-bus system might reduce the 15 cents-a-mile subsidy for each rider by 4 cents or 27 percent.

bus service might, on balance, have attracted the same levels of patronage. If all transit patronage in 1985 had been on the bus service that existed in 1980 (redeployed to meet changes in travel patterns), transit costs could have fallen to around 23 cents a passenger mile in both Washington and Atlanta, and to between 30 cents and 40 cents a passenger mile in the other cities. These lower costs could have meant substantial reductions, at current fares, in the operating subsidies. In Washington, where fares are relatively high (that is, fares in Washington cover nearly 40 percent of cost compared with a national average of 37 percent), the subsidy might have been reduced by as much as 75 percent. In other words, if investment had been geared to lowering costs of service, and if service had been managed so as to maximize the effective deployment and productivity of bus fleets, operating subsidies could have been held in check in many of the larger cities, even at current fare levels.

THE OUTLOOK

Unless it is restructured, federal transit aid will continue to be at cross-purposes. Cities other than the largest will increasingly not be able to spend their excess formula dollars except by converting them to fare subsidies, by shortening capital replacement cycles, or by other artificial devices. These irrational incentives will undermine the efforts in many transit agencies to strengthen capital planning by applying standards of cost-effectiveness to investment planning. Moreover, formula assistance will be available for more special projects as modernization needs tail off, and demands for discretionary aid will narrow to new starts (and extensions of earlier new starts). But the current crop of proposed new-start projects is no better than the new starts already in service in terms of their likely adverse effects on transit costs and ridership.

There is limited scope for effective investment within the federally funded transit aid program, other than possibly in a few cities where commuter rail services still need modernizing. The bus services have a 20 percent surplus of vehicles, sufficient to replace obsolescent vehicles over about the next three years without new purchases (on a national basis). But raising the very low productivity of the bus fleet could allow both fleet replacements and transit service expansion, in

ways that reduce operating subsidies without raising fares, for many years to come. Raising average load factors on buses from 20 percent to 30 percent, for instance, would absorb all the growth in transit use in the next 30 years, and would also reduce operating subsidies at current fares by one-third. In short, better management of the existing bus fleet would largely obviate the need for new investment other than long-term fleet renewal.

Proposed new rapid rail projects are not likely to prove more cost-effective than the others discussed here. The systems to be constructed with federal assistance in Los Angeles, Seattle, St. Louis, and Houston may only add to the costs of transportation service in those cities without attracting enough new riders to reduce the need for operating subsidies.[10] Other new projects include extensions of the Washington, Miami, and Atlanta rapid rail systems, which, as shown earlier, have not added to the ridership and affordability of transit service in those cities as much as improvements in bus service would have.

Many transportation analysts and economists argue that the poor showing on rail transit projects reflects not simply poorly designed systems but a fundamentally wrong choice of transit technology.[11] Transportation requirements are governed by the public's preference for suburban living, the growth of jobs mainly in the suburbs, and the dispersal of trip origins and destinations. Some form of bus transit will inevitably be cheaper, more effective, and of higher quality than any rail system in most U.S. cities. Even large-bus services may be the wrong technology insofar as they reduce service frequencies and increase passenger waiting times, thus discouraging use.[12] A 1986 CBO study found that, in a generalized case, overall transit costs including bus operations and passenger time would be 20 percent to 25 percent lower on a route with small buses (25 seats or fewer) than on a route with large buses (more than 35 seats) because of reductions in waiting times.[13] This is another way in which federal willingness to

10. Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986).

11. Kain, "Choosing the Wrong Technology."

12. See, for example, A.A. Walters, "Externalities in Urban Buses," *Journal of Urban Economics*, vol. 11 (January 1982).

13. Congressional Budget Office, *Federal Policies for Infrastructure Management.*

finance new systems may have inappropriately influenced local investment choices.

Finally, buses equipped to provide special services for elderly and handicapped transit users are at least five times as expensive and consume twice as much energy as regular buses. In many cases, levels of service could be raised significantly by using other modes of transportation for these special services rather than continuing to invest in specially equipped buses.

Leaving these negative considerations to one side, improvements can be made in the effectiveness of transit services. All cities face growing urban traffic congestion on at least some main routes, and in nine states urban congestion is severe. This study estimates that although highway construction in general will not provide attractive investment returns in the 1990s, highway expansion projects to relieve urban traffic delays could earn between 10 percent and 20 percent on the investments, provided that no cheaper or more effective ways can be found to free up traffic (see Chapter I). As an alternative, getting more from the existing infrastructure by encouraging higher vehicle occupancies in both public and private uses will often be more cost-effective than new highway construction, and will provide faster as well as more lasting reductions in traffic delays.

POLICY OPTIONS FOR THE FEDERAL TRANSIT PROGRAM

With modernization mostly completed, federal transit policies could be redirected toward long-term goals for public transportation--reductions in urban congestion and pollution, and mobility for those dependent on public services. Since most of the benefits and costs of transit operation are local, and since efficient urban transportation depends on wider programs that also encompass highway development, land use, congestion, and parking arrangements that a transit assistance program does not easily address, the range of policy options is broad. At one end, having restored transit in most cities, the federal government has the opportunity to walk away and allow financial and market forces to determine the future of public transit. Alternatively, federal transit aid could be restructured, in the recognition that transit systems have entered a steady state of fleet replacement cycles, to

provide incentives for productivity enhancements in urban transportation and to make services more available to special transit-dependent groups such as the handicapped or the elderly.

Withdraw Federal Financial Aid

Federal aid now provides over 70 percent of investment spending and about 15 percent of operating subsidies nationally, so that nearly one-quarter of the national transit budget is financed federally. Replacing these resources would require a variety of responses from local governments. Many agencies would be forced to improve efficiency, raise fares, find new local sources of finance, and/or modify services.

Some proponents of this option argue that decisions about transit service, like those about other municipal services, should be made locally; and that now that the fleet modernization backlog has been overcome by assisting in the purchase of 67,000 buses and 7,000 rail cars since 1965, federal support is no longer essential. Others maintain that the federal subsidies themselves are a major cause of the poor efficiency and high cost of transit service.[14] From this point of view, ending the subsidies would help force efficiency improvements in transit management.

A strong government role in transit is often seen as benefiting not only transit users but the general public through side effects such as reduced pollution and less traffic congestion. Certainly, increasing the average number of riders in each vehicle lowers overall cost and fuel consumption (and hence emissions) for any given amount of traffic. But such benefits are not in themselves an argument for federal transit policies. First, other strategies might provide them more effectively. Data from transit agencies (summarized in Table 7) show that at current levels of productivity the cost per passenger mile of vanpooling is about one-third that of bus service, while its fuel efficiency is over three times greater. Since private vanpools and carpools carry about four times the traffic of public transit (20 percent of work trips compared with 5 percent), the broad benefits from private ride-sharing

14. See, for example, Urban Mass Transportation Administration, *The Status of the Nation's Local Mass Transportation: Performance and Conditions*, Report to Congress (June 1987).

must now be running at about 12 times those contributed by public transit services.

Second, 25 years of experience have shown that even high levels of government subsidy (from all governments) do not make transit broadly attractive to the public. The subsidies have not overcome factors that work against transit--the preference for low-density suburban living even with long commutes, the practices of including company cars and free parking in employee benefits, and low fuel prices. From a national point of view, many of the benefits sought through public transit have instead been provided by private transportation arrangements, while much of the subsidy intended to encourage transit use has been nullified by local community and business practices that favor drive-alone commuters.

Much is made of the superior efficiency of private transit over public transit, and, indeed, "privatization" has been a plank of the Administration's approach to federal transit policy for at least the last four years. But the benefits of privatization--other than through a full-scale deregulation of public transportation services in the cities--should not be made an argument for a federal withdrawal from transit assistance. Since the federal assistance program began, transit has passed from being largely private (64 percent of the transit fleets in cities of 50,000 or more were under private ownership in 1960) to mostly public (only 7 percent of those fleets are now privately owned). Current experience with privatization is of limited scope, mostly concerned with contracting out or franchising by public agencies rather than with encouraging competitive service by private firms. Much of the cost saving shown in privatization studies stems from experiments in contracting out small parcels of the public service in order to avoid the cost-increasing features of large-scale transit agencies--high peaking, difficulties in fleet deployment, high overheads, and so on.[15]

If contracting in itself aids efficiency, it is through the attention to transit performance that makes contracts rewarding to bidders. Such potential savings are available to all transit agencies, whether publicly or privately managed, if they are given incentives to improve effi-

15. For a discussion of these results, see Urban Mass Transportation Administration, *Status of Local Mass Transit* (Chapter 7).

ciency by pursuing performance goals.[16] It is not realistic to expect a privately operated transit monopoly to be more efficient than a publicly operated monopoly if neither is required to meet agreed-upon performance targets. Financial failures among the private transit monopolies of the 1950s and 1960s were, after all, one factor prompting federal entry into transit financing.

Lasting benefits from privatization will arise only if cities foster competitive transportation services. But if the federal government--by far the minority partner in financing transit--were to withdraw its aid, this would not be likely to encourage many cities to sell off their transit agencies in favor of competitive private service. In fact, most cities with anything salable would find a federal withdrawal manageable. The expansion needs of all but the major rail systems over the next several years could easily be met by improving the productivity of existing capital, thus reducing the need for new capital subsidies. As far as operating subsidies go, more than three-quarters of the national transit ridership is on systems that rely on federal operating aid for only 8 percent of their revenue (the national average for both bus and rail companies) or less; altogether, over 93 percent of transit use is on systems for which federal operating subsidies are one-sixth or less of revenue. Only three cities with populations above 1 million are not included in the low-subsidy group--Kansas City (19 percent of revenue from federal aid), Fort Lauderdale (20 percent from federal aid) and Buffalo (17 percent from federal aid).[17] Of these three cities, only in Buffalo is transit use more than 10 percent of commuting. While a federal withdrawal would require adjustments, agencies handling the great bulk of transit service could fill the gap with some combination of relatively small adjustments: improvements in productivity, cost-cutting measures, fare increases, and support from local governments.

Some agencies would be hard hit, however. Local transit agencies that use federal operating aid at more than twice the national rate (for more than one-sixth of their revenue) carry only 7 percent of national transit ridership but account for 27 percent of federal operating sub-

16. These points are discussed in Anthony U. Simpson, "Implications of Efficiency Incentives on Use of Private Sector Contracting by the Public Transit Industry," in Charles A. Lave, ed., *Urban Transit, The Private Challenge to Public Transportation* (Cambridge: Ballinger, 1985).

17. Urban Mass Transportation Administration data.

sidies. This list includes the smallest 200 cities receiving federal aid, all but three of them with populations under 1 million. But if cities in this group would have most to lose from a withdrawal of federal aid, they would potentially have much to gain also: their transit services now are among the least efficient, and pressure to reduce costs could only improve them. This was certainly the effect of the withdrawal of federal subsidies from Conrail and also, to a lesser extent, of reductions in federal support for Amtrak.

On the negative side, a withdrawal of federal aid might work against the federal interest in a balanced development of the highway system by giving communities an incentive to build more roads as a way of solving urban traffic problems. Also, transit-dependent groups might be hurt if transit agencies reduced special services as a cost-cutting measure. This latter possibility is of most concern in cities with 1 million or fewer people where transit is not a major commuter mode but is used for shopping, hospital, and social trips by those without autos. In larger cities, the availability (if not always the accessibility) of services for noncommuters may be assured to some degree by the demand for commuter service. In localities where transit-dependent groups might suffer from a cessation of federal aid, one remedy might be to redesign the federal regulations governing special services for elderly and handicapped riders, particularly if smaller cities opted to deregulate or to sell transit franchises to private operators. Alternatively, transit vouchers (discussed in the following section) might be a way of protecting the interests of special groups in the event of a federal withdrawal from general transit aid.

Restructure Federal Assistance

Restructuring federal assistance could open the way for new policies that would recognize past accomplishments in modernizing transit, reward cities that adopt efficient urban transport policies, and foster improvements for those dependent on transit services. The new policies would also reflect a refocusing of federal interest from urban renewal and fuel conservation in the 1960s and 1970s to suburban traffic and pollution problems in the 1980s and 1990s. A restructured aid program following these principles could consist of two types of payments:

- A combined grant, set at a fairly low share of transit operating and capital replacement costs; and

- Vouchers issued to transit-dependent individuals, redeemable for transportation service provided by any supplier, public or private.

There is no obvious level at which to fund a restructured assistance program. Equally strong arguments could be made for continuing the present level of aid, increasing it, or reducing it. The following discussion assumes the first alternative, based on the CBO 1990 baseline for transit assistance of $3.6 billion a year.

The Combined Grant. The only payment that would be made to all transit agencies under such a restructured program would be a basic grant. If it was set at a fixed amount per passenger mile, the grant would simply reflect the amount of transportation provided by each agency. A fixed payment per passenger mile would make transit agencies or their local sponsors responsible for financing increases in the revenue gap, whether these increases arose on the cost side or as fare discounts, but would reward managers who increased ridership. In this way it would provide an incentive to contain costs and develop patronage.

The grant would cover some portion of operating expenses plus an allowance for a share of capital depreciation. Although some large and medium transit agencies use advanced capital planning systems, many agencies continue to do their capital accounting on a cash basis. Including depreciation allowances in the grant (thus paying for a share of capital as it is used rather than as it is bought) would encourage the introduction of modern methods for planning the use and replacement of transit fleets.

In setting the appropriate amount for the combined payment, broad principles suggest that it be consistent with efficient use of facilities and good management practices. A single rate of payment per passenger mile could reflect some long-term productivity target--say, a specific load factor. A declining rate per passenger mile would imply gradually increasing productivity over a number of years. A single rate based on a long-run productivity target for transit could have the highest productivity-enhancing effect and cost the least. If it

was based on the current average of federal payments, adjusted to, say, a 45 percent average load factor, the rate would range from around 6.5 cents a passenger mile for bus services to nearly 11 cents (because of higher depreciation charges) for rapid rail systems. Assuming 1985 traffic, payments at these rates would be $2.8 billion a year. Since fewer than 20 systems achieve 45 percent loadings, almost all agencies would be given an incentive to raise their performance or lower their costs.

In-City Transportation Vouchers. Federal transportation vouchers could help transit-dependent groups obtain better service. Transit-dependent users would be defined as those whose choices are limited by physical requirements--as, for example, some of the elderly or handicapped--or by poverty. Though commuters in major cities may be said to be transit-dependent, they are relatively affluent (typically white-collar workers with incomes above $20,000) and would not qualify for vouchers.

Under federal rules, transit agencies receiving federal assistance must develop a program of special services to provide for elderly and handicapped patrons, using at least 3 percent of their budgets.[18] So far, agencies have tended to provide such services with relatively expensive transportation systems, so that the effectiveness of the special budgets has been limited. Vouchers allowing elderly and handicapped riders to pay for taxis, buses, and trains, or to buy gas for the family car, would increase the options available for many of them and encourage transit agencies to be more responsive to their needs in planning special services budgets.

Cities that have used vouchers to provide services for the elderly or handicapped report significant cost savings because many of the target group do not need special equipment--lifts, and so on--and can use regular bus or taxi service. The Congressional Budget Office has

18. Federal regulations allowing agencies to cap allocations for special services for elderly and handicapped riders at 3 percent of their operating budgets were recently overruled, on the grounds that the cap is arbitrary and hence does not meet the minimum service requirements of the 1982 Surface Transportation Assistance Act or the 1973 Rehabilitation Act. See the ruling of Judge Marvin Katz in the U.S. District Court for the Eastern District of Pennsylvania, January 1988.

estimated that 80 percent of disabled or elderly people could use regular transportation systems with only minor modifications.[19]

The question of who would be eligible for vouchers raises issues of policy. Currently, the explicit federal policy is that special efforts be made for elderly and handicapped users of transit services. Federal operating assistance obliquely aids other dependent groups--the young, the poor--by helping to hold fares as low as they are. In addition, many people with low income receive federal income supplements under welfare programs, and if additional assistance is appropriate, questions would arise whether transit vouchers, food stamps, or other benefits were more appropriate. If the main intent of federal assistance for transit was to assist the poor, the elderly, and the disabled, then all of the transit assistance--$3.6 billion--could be paid to them in voucher form in lieu of federal aid to transit agencies.

If transit assistance was limited to the $3.6 billion mentioned earlier, then the combined payment discussed above ($2.8 billion in combined grants at 6.5 cents a passenger mile) would leave about $800 million for voucher assistance. This level represents about one-fifth of current federal aid (including capital and operating assistance) and about two and one-half times what transit agencies would budget under the 3 percent rule for special services. Even so, it would be enough to provide transit vouchers worth approximately the average annual federal subsidy per commuter (about $100 to $160 at a basic bus subsidy rate of 6.5 cents a passenger mile, or $180 to $260 at 11 cents for rail) for each of the 5 million or so disabled people who find transit difficult to use. It would provide a much higher rate of assistance for the million or so severely disabled, blind, or deaf people living near transit but unable to use regular services. Spread over more recipients, the subsidy would be less than that for commuters generally; but a larger number of recipients might have more bargaining power in their efforts to improve transit services than transit-dependent groups have at present.

19. Statement of Alice M. Rivlin, Director, Congressional Budget Office, before the Subcommittee on Housing and Urban Affairs of the Senate Committee on Banking, Housing and Urban Affairs, May 20, 1981.

An argument against vouchers is that states and localities are responsible for making transit accessible to all users, and that some would become lax in their efforts if federal vouchers were introduced. The net gain in mobility from using vouchers might thus be much less than the level of aid offered. Also, though vouchers are preferable to agency subsidies in directing assistance to target groups, they are less efficient than cash payments of the same value unless they can be traded dollar-for-dollar for cash. Food stamps can be exchanged for their face value in cash, but whether transit vouchers would be equally exchangeable would depend on the value of transportation services in household budgets.[20]

20. See for example, Daniel S. Hamermesh and James M. Johannes, "Food Stamps as Money: The Macroeconomics of a Transfer Program," *Journal of Political Economy*, vol. 93, no. 1 (1985).

CHAPTER III

AVIATION

Deregulation of the domestic airlines during the 1980s has greatly increased the demands on aviation infrastructure and the need for federal aviation services. Yet there has been no change in the structure of federal programs for developing aviation infrastructure since the Airport and Airway Trust Fund was enacted in 1970. Change has been hindered by concern about the persistent, large uncommitted balance in the trust fund. Confusion as to the role of the fund has obscured the real levels of federal subsidies to air travelers.

THE CHANGING FEDERAL ROLE IN AVIATION

The government's interest in aviation began as a user of aviation services, but quickly shifted to that of a regulator of flying activity. As with highways, federal interest in air transport was initially as a means to deliver the mails. As early as 1920, when private flying was still at best a chancy affair, the U.S. Air Mail Service provided transcontinental deliveries. By 1924 it was making daily flights. The Air Commerce Act of 1926 broadened the federal role to one of promoting aviation as a mode of commercial transportation by establishing and policing safety standards for aviators and their equipment.

The Growth of Regulation

The 1938 Civil Aeronautics Act set up two new institutions: a federal air traffic control service for commercial aircraft (based in part on towers taken over from private operators during the 1930s), and a separate agency, the Civil Aeronautics Board (CAB), to undertake economic and safety regulation. In 1958, the Federal Aviation Act consolidated civil and military air traffic control in a new agency (now the Federal Aviation Administration, or FAA, in the Department of

Transportation) that also took over authority for safety standards for aircraft and aviation personnel from the CAB.

The federal government also provided significant financial support for airport development. The Federal Airport Act of 1946 first authorized federal assistance for airport investment. The resulting federal aid to airports program provided nearly half the capital spending on airports between 1947 and 1969.[1] Until 1987, when they were leased to a regional commission, the two commercial airports serving Washington, D.C., were developed and operated by the federal government.

The Airport and Airway Trust Fund

Two changes made in the 1970s continue to influence federal aviation policy. First, the Airport and Airway Development Act of 1970 established the Airport and Airway Trust Fund to collect taxes from aviation users and disburse them for aviation programs. The trust fund, which took over several existing taxes, became the source of airport development grants, of financing for air traffic control investments, and of some FAA funding.

From the first, confusion and controversy surrounded the purposes of the trust fund. The Congress wanted to use the fund to finance modernization and development of the aviation system; the Administration wanted to use it to finance the FAA. Conflict arose in the first year over the Administration's proposal to reduce capital spending to well below what had been authorized and to apply the balance of trust fund revenue to FAA operations. This would have meant funding 70 percent of FAA operations from the trust fund, or more than the total spending for aviation capital programs. At the time, airport delays were lengthy and the Administration was criticized for not using the earmarked taxes to increase capacity. In 1971, an amendment to the Airport and Airway Development Act of 1970 (Public Law 92-174) revoked trust fund financing of FAA operations.

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1. John R. Wiley, *Airport Administration and Management* (Westport, Conn.: Eno Foundation, 1986).

But many Members of Congress, as well as many Administration officials, felt that the aviation user taxes should cover more federal spending for the FAA. In 1973, the trust fund began to accumulate a cash surplus above the annual spending for capital programs. Authority to finance some FAA operations from the trust fund was restored in 1976, with safeguards to ensure priority for capital spending. Successive reauthorizations of the trust fund have restricted its support for FAA operations, while increasing authorized spending for airport development and, since 1982, for investments in air traffic control. As a result of caps on trust fund financing for operations, and penalties imposed when capital spending falls below specified levels, it is not clear whether aviation users are expected to pay their way.[2]

Deregulation

The second important policy change in the 1970s was the passage of the Airline Deregulation Act in 1978. The Congress set up a timetable to phase out the CAB's economic regulation of the domestic airlines by the end of 1984. In fact, deregulation was achieved much earlier. Through administrative actions of the CAB, domestic airlines were effectively freed of federal restrictions on routes and fares by the spring of 1980. Airfreight services had been deregulated in 1977.

Recent Legislation

The 1987 Airport and Airway Safety and Capacity Expansion Act reauthorizes aviation infrastructure programs. It calls for increased aid from the trust fund for airport development and for FAA modernization. It also continues subsidies for air services to small communities (first authorized under the Airline Deregulation Act of 1978) and trust fund financing for the aviation weather services of the National Oceanic and Atmospheric Administration (first authorized for 1983, although investment to improve aviation weather information has always been financed from the trust fund).

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2. A lengthier discussion of these points will be contained in a forthcoming Congressional Budget Office report on the status of the Airport and Airway Trust Fund.

Operations of the FAA are to be financed both from the trust fund and from federal funds. But aviation tax rates will be reduced by 50 percent in calendar year 1990 if in 1988 and 1989 obligations for airport grants plus amounts made available for FAA facilities and equipment plus amounts for FAA research, engineering and development are less than 85 percent of the total authorized. Under CBO's 1988 baseline projections, this tax reduction is expected to occur. Despite the revenue falloff, the uncommitted portion of the trust fund's cash surplus is projected, in CBO's baseline, to fall by only one-third, from $6 billion at the end of 1988 to $4 billion at the end of 1993.

ACHIEVEMENTS

Fundamental changes in air transportation during the 1980s have altered the structure of demand for aviation infrastructure and federal aviation services. Deregulation has improved the efficiency of air transportation and made it cheaper and more accessible. Major changes in the network of air routes have led to new patterns of demand for airports and for air traffic control. At the same time, growing traffic has renewed congestion at major airports, and some people call for traffic restrictions to maintain safety levels.

Federal aviation policies have fostered an aviation industry that is largely self-supporting: of the $70 billion in annual spending for aviation facilities and services in 1986, only about 7 percent came from federal budgets (see Table 10). Yet federal budgets support critical elements on which the efficiency of air transport rests. All costs of the airway system (that is, for air traffic control and other navigation services that determine the flow of aircraft traffic and its access to airports) are paid federally, and federal airport grants pay about one-fifth of airport investment.

But federal assistance has not been very effective in meeting the needs of the aviation system as a whole. Confusion over who pays for aviation aid--born in the confusion over what the Airport and Airways Trust Fund should finance--and the contradiction between the trust fund's large balances and the need for capital investment, have obscured policymaking. Major commercial airports have had to raise most of their own development capital. Federal aid, rather than focus-

ing on expanding the capacity of major airports, has gone disproportionately to small commercial airports and to airports serving general (nonscheduled) aviation flights by small aircraft. This sector, which pays the lowest share of costs into the trust fund and gets the most generous aid from it, has declined continuously over the past nine years. Meanwhile, the continued effectiveness of the air traffic control system, which determines the capacity of the aviation system overall, is threatened by delays in completing the 1982 modernization plan, and by poor pricing of landing and take-off slots.

Three questions arise in assessing federal aviation assistance:

- Who pays for federal aviation infrastructure aid and services?
- How effective is federal airport aid in building aviation capacity? and
- How well is the air traffic control system working?

Who Pays for Federal Programs?

The Airport and Airway Trust Fund finances about 28 percent of airport and airway expenditures. Airline passengers finance most of the trust fund: nearly 90 percent of the trust fund's revenue is from the tax on domestic airline passenger tickets (see Figure 4). In every year since 1973 (except 1981 and 1982), the trust fund has collected more in taxes than it has disbursed; in the 1983-1987 period, fund revenue surpassed outlays by $2.5 billion.

In recent years, however, an equal amount of airport and airway spending has been financed outside the trust fund, by the general taxpayer. Figure 5 shows federal funding sources in 1986. Whether spending from federal funds represents a subsidy by the general taxpayer to aviation users depends upon how costs are apportioned between federal and nonfederal purposes. Federal use of the air systems is mainly military, while nonfederal users are principally commercial and general aviation. Aeronautical research potentially benefits both

TABLE 10. NATIONAL FINANCING FOR AVIATION FACILITIES AND SERVICES, 1986
(In billions of dollars)

Type of Expenditure	Airport and Airway Trust Fund[a]	Federal Funds[b]	Nonfederal Funds[c]	All Spending
Airports				
Investment[d]	0.9	0.0	1.3	2.2
Operations[d]	0.0	0.0	2.3	2.3
Standards	e	e	0.0	e
Subtotal, Airports	0.9	0.0	3.6	4.5
Percent of All Spending	19	0	81	100
Airways				
Investment	0.8	0.0	0.0	0.8
Research	0.3	0.0	0.0	0.3
Operations	0.4	2.2	0.0	2.7
Other	0.0	0.1	0.0	0.1
Subtotal, FAA	1.5	2.3	0.0	3.8
National Oceanic and Atmospheric Administration	e	0.0	0.0	e
Subtotal, Airways	1.5	2.3	0.0	3.8
Percent of All Spending	39	61	0	100
Subtotal, Airports and Airways	2.3	2.3	3.6	8.3
Percent of All Spending	28	28	44	100
Other Public Services				
Aeronautical Research	0.0	0.3	3.4[f]	3.8
Department of Transportation Air Policy	0.0	e	0.0	e
National Transportation Safety Board (Part)[g]	0.0	e	0.0	e
Aircraft Purchase Loan Guarantee Program	0.0	e	0.0	e
Subtotal, Other Public Services	0.0	0.4	3.4	3.8
Percent of All Spending	0	10	90	100

(Continued)

TABLE 10. Continued

Type of Expenditure	Airport and Airway Trust Fund[a]	Federal Funds[b]	Nonfederal Funds[c]	All Spending
		(Continued)		
Subtotal, Airports, Airways and Public Services	2.3	2.7	7.1	12.1
Percent of All Spending	19	22	58	100
		Air Transport Services		
General Aviation	0.0	0.0	7.6	7.6
Commercial Services				
Domestic passenger services	0.0	0.0	36.6	36.6
International passenger services	0.0	0.0	6.6	6.6
Freight services	0.0	0.0	7.2	7.2
Subtotal, Air Transport Services	0.0	0.0	58.0	58.0
Percent of All Spending	0	0	100	100
Total Expenditures	2.3	2.7	65.1	70.1
Percent of All Spending	3	4	93	100

SOURCE: Congressional Budget Office, based on data from federal and agency budgets, the Department of Transportation, the Bureau of the Census, and Transportation Policy Associates.

a. Paid from dedicated taxes on users.

b. Paid from general revenue.

c. Paid from state, local, or private funds. Most airports are reimbursed for capital and operations expenditures from charges on users.

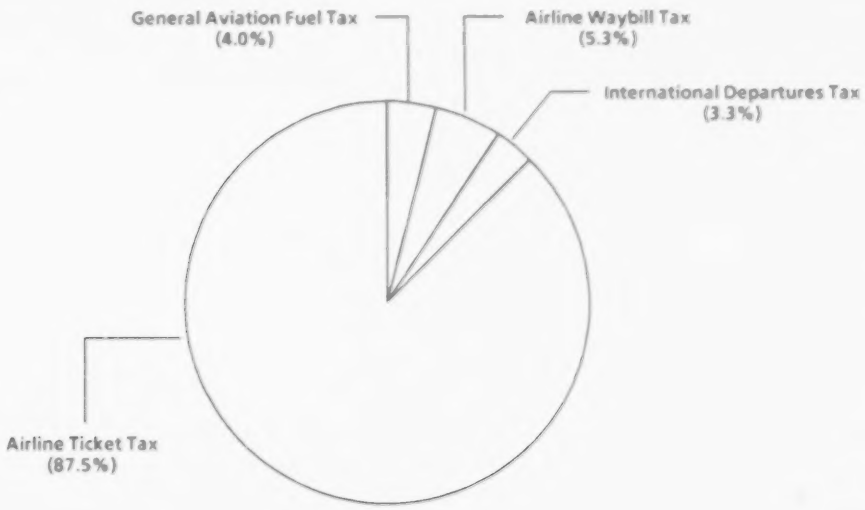
d. Federal expenses for the National and Dulles airports serving Washington, D.C., are included with nonfederal funds to reflect the airports' 1987 transfer to a regional commission.

e. Less than $50 million.

f. Nonfederal funds figure is for 1983, and includes some financing for missile R&D.

g. An arbitrary 50 percent of NTSB activities is attributed to aviation.

Figure 4.
Sources of Revenue for the Airport and Airway Trust Fund, 1983-1987



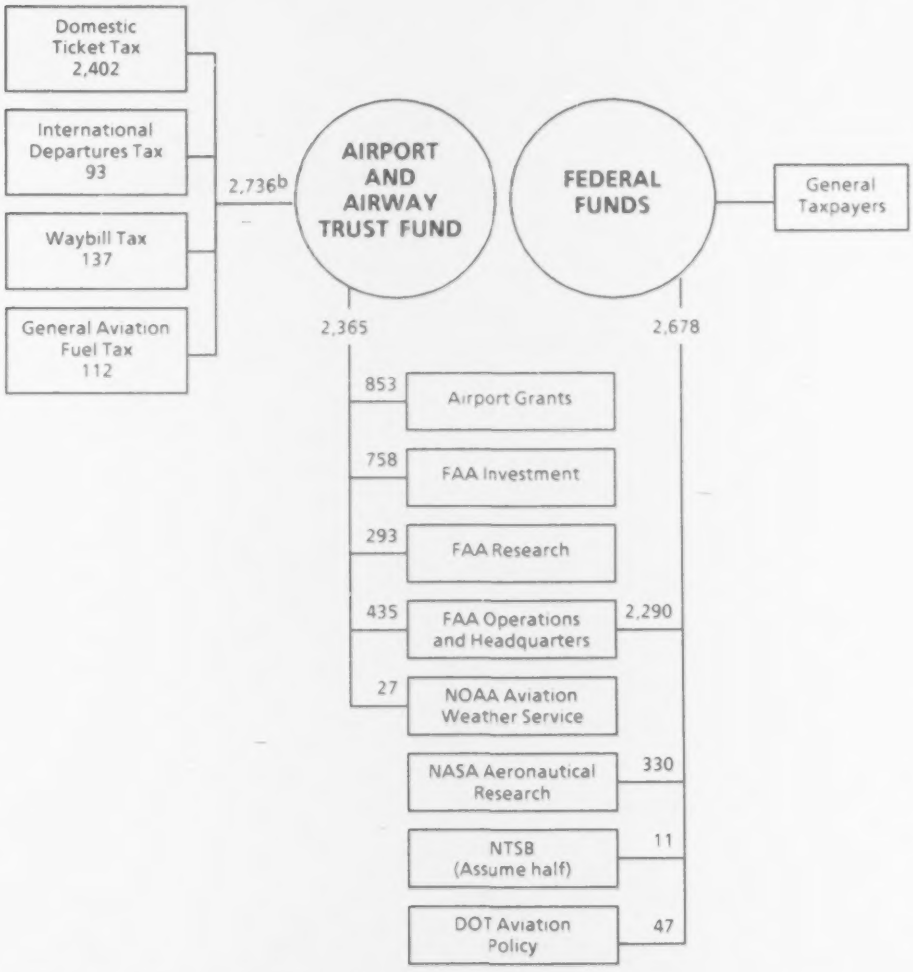
SOURCE: Congressional Budget Office, from federal budget data

military and civilian flying. Policy administration by the government may promote broad national purposes for trade or regional development, as well as the direct interests of aviation firms and their customers.

The most clearly identifiable federal subsidy for aviation interests is made through the air navigation system. The FAA has estimated that 85 percent of the use of the air navigation system is attributable to nonfederal users.[3] If that is the case, since the trust fund share of FAA outlays in 1988 is estimated to be 56 percent, the additional 29 percent coming from general revenues can be characterized as a subsidy for nonfederal users of the system.

3. Daniel E. Taylor, *Airport and Airway Costs: Allocation and Recovery in the 1980s*, Final Report, U.S. Department of Transportation (February 1987).

Figure 5.
Federal Funding for Airports and Airways in 1986
(In millions of dollars)[a]



SOURCE: Congressional Budget Office, based on federal budget data.

NOTES: FAA = Federal Aviation Administration.
NOAA = National Oceanic and Atmospheric Administration.
NASA = National Aeronautics and Space Administration.
NTSB = National Transportation Safety Board.
DOT = Department of Transportation.

a. Excludes federal spending on Washington metropolitan airports, which were transferred to a regional authority during 1987.

b. Excludes tax refunds of $8 billion.

Other federal subsidies are harder to identify. Aviation research outlays in the National Aeronautics and Space Administration's budget have totaled $5.6 billion over the last 10 years; they were $635 million in 1987. Allowing only for the direct purposes of the research would give about a 50-50 split in spending between military and civilian projects.[4] But research expenditures are difficult to assign between federal and nonfederal users, particularly because research applications may spill over from civilian to military flying (and vice versa). Whether and how policy spending--for example, that of the Civil Aeronautics Board and current Department of Transportation policy programs, principally for international aviation and consumer protection--could be apportioned among federal and aviation interests is problematic.

Table 11 shows the official estimate and an alternative estimate of the balance between user taxes and aviation spending. According to the official data, the trust fund has accumulated a cash balance of $10 billion.[5] The alternative estimate shows, however, that this balance represents a transfer from general taxpayers to aviation interests. If 85 percent of FAA spending--the proportion attributed to nonfederal users--had to be financed from the trust fund, the fund would have required supplements from general funds in every year. Under this accounting, cumulative federal subsidies for aviation over the life of the trust fund are close to $16 billion, over half as much again as the official fund cash balance. In other words, aviation users have received much more from federal budgets (considering both trust fund and federal fund spending) than they have contributed in dedicated taxes.

Does Federal Aid Add to Capacity?

Federal airport aid adds little to the facilities needed for commercial air transportation. A 1984 CBO study showed that the role of federal programs in financing the major commercial airports was relatively small. Between 1978 and 1982, commercial airports raised an average

4. National Aeronautics and Space Administration, *Vertical Cut Analysis* (February 1988).

5. Of this amount, the uncommitted balance is $5.6 billion.

TABLE 11. ALTERNATIVE ESTIMATES OF AVIATION TAXES AND SPENDING, 1971-1987 (In billions of dollars)

Fiscal Year	User Taxes	Actual Trust Fund			Alternative Estimate		
		Outlays	Interest	-Cash Balance[a]	Total FAA Outlays[b]	85 Percent of FAA Outlays	Taxes minus 85 Percent of Outlays
1971	0.6 [c]	0.3	0.0	0.9	1.5	1.3 [d]	-0.8
1972	0.6 [c]	1.4	0.0	1.1	1.6	1.4 [d]	-0.7
1973	0.8 [c]	0.7	0.0	1.2	1.8	1.6 [d]	-0.8
1974	0.8	0.5	0.0	1.5	1.9	1.6 [d]	-0.7
1975	1.0	0.6	0.1	2.0	2.0	1.7 [d]	-0.7
1976	0.9	0.5	0.1	2.6	2.1	1.8	-0.9
TQ[e]	0.3	0.1	0.0	2.7	0.5	0.4	-0.1
1977	1.2	0.9	0.2	2.3	2.4	2.0	-0.8
1978	1.3	1.1	0.2	3.7	2.8	2.4	-1.0
1979	1.5	1.1	0.3	4.4	2.8	2.4	-0.9
1980	1.9	1.2	0.4	5.4	3.1	2.7	-0.8
1981	1.2 [f]	1.3	0.6	4.7	3.2	2.7	-1.5
1982	1.2 [f]	1.5	0.5	3.9	2.9	2.5	-1.3
1983	2.2	1.8	0.5	4.8	3.4	2.9	-0.7
1984	2.5	1.4	0.5	6.4	3.8	3.3 [g]	-0.8
1985	2.9	2.6	0.7	7.4	4.3	3.7 [g]	-0.8
1986	2.7	2.4	0.8	8.6	4.7	4.0 [g]	-1.3
1987	3.1	2.6	0.9	9.9	4.9	4.2 [g]	-1.1
Total	26.6	22.0	6.0		49.7	42.4	-15.8

SOURCE: Congressional Budget Office, based on budget data.

a. End-of-year cash balance.

b. Total FAA outlays are the sum of expenditures from the Airport and Airway Trust Fund and from federal funds, as shown in Table 10.

c. Data do not include transfers to the trust fund of unexpended appropriations of $621 million in 1971 and $255 million in 1972, or supplementary payments from general revenue of $647 million in 1972 and $73 million in 1973.

d. Data include spending for the Aviation Advisory Commission during the 1971-1975 period.

e. Transition quarter between fiscal year ending June 30, 1976, and fiscal year running from October 1, 1976, to September 30, 1977.

f. Data do not include aviation tax receipts of $1.2 billion in 1981 and $1 billion in 1982 that were not credited to the trust fund.

g. Data include trust-fund transfers to the National Oceanic and Atmospheric Administration for the aviation weather service, beginning in 1984.

of $1 billion annually (at 1982 prices) in bond issues for capital projects, at which rate they would have been able to finance most of their projected capital needs for the remainder of the 1980s.[6] Since major airports typically offer investment-grade bonds, ensuring their ready sale at reasonable interest costs, the airlines can often lease the improved facilities at rates lower than if they built the facilities themselves.

As noted earlier, federal aid to small commercial airports and to general aviation (nonscheduled flying) terminals has been relatively much more important and more generous than has federal assistance to the major airline airports. More than 60 percent of national airport investment occurs at large and medium hub airports, and federal grants constitute one-quarter or less of that; grants increase their share rapidly as the size of the airports declines (see Table 12). Grants finance three-quarters or more of investment in general aviation reliever facilities (built to attract nonscheduled traffic away from airline airports) although these undertake only 6 percent of national investment; grants also finance around 80 percent of improvements at small terminals for both commercial flights and nonscheduled flying. In sum, most of the capital projects at general aviation and reliever airports are financed from federal capital grants; subsidies to these two groups absorb 30 percent of federal airport assistance (see Figure 6).

Federal aid for small commercial airports has helped the communities they serve maintain communications links. Thus it may be said to meet a national purpose. But aid for general aviation has not been effective in meeting its goal of relieving traffic congestion at major points. Very little general aviation traffic is handled by airports subject to chronic long-term congestion. At Chicago's O'Hare Airport, for example, only 5 percent of flights are general aviation; at the three main New York area airports, general aviation is only 8 percent to 9 percent of flights; at Boston's Logan Airport, general aviation accounts for just over 10 percent of all arrivals and departures. These figures reflect both the high levels of scheduled airline service to these airports, and the pressure on facilities that allows relatively poor accommodation for general aviation. Thus, for many years, improve-

6. Congressional Budget Office, *Financing U.S. Airports in the 1980s* (April 1984).

TABLE 12. SOURCES OF AIRPORT INVESTMENT

Airport Category	Number of Airports[a]	Percent of National Investment	Source of Investment (As percent of total) Federal Grants	Bond Proceeds	Other
All Airports	3,243	100	35-40	50-65	Under 15
Commercial Airports					
Primary					
Large hubs[b]	29	43	20	80-100	i
Medium hubs[c]	43	19	25	60-80	Under 15
Small hubs[d]	67	13	40	20	40
Nonhubs[e]	139	5	60	20	20
Other Commercial[f]	272	5	80	20	0
General Aviation Airports					
Relievers[g]	244	6	75	8-10	Over 17
Other General Aviation[h]	2,449	10	75-80	i	Under 25

SOURCES: Congressional Budget Office, *Financing U.S. Airports in the 1980s* (April 1984); and Federal Aviation Administration, *National Plan of Integrated Airport Systems (NPIAS) 1986-1995* (November 1987).

a. Includes airports classified by the FAA as in the National Plan of Integrated Airport Systems.

b. Large hubs enplane 1 percent or more of national revenue passengers.

c. Medium hubs enplane between 0.25 percent and 1 percent of national revenue passengers.

d. Small hubs enplane between 0.05 percent and 0.25 percent of national revenue passengers.

e. Nonhub airports enplane between 0.01 percent and 0.05 percent of national revenue passengers.

f. Other commercial airports are all other airports that enplane more than 2,500 revenue passengers annually.

g. Reliever airports are airports in metropolitan areas that are intended to reduce congestion at large commercial service airports by providing alternative landing areas. Most relievers handle only general aviation; some also handle commercial flights.

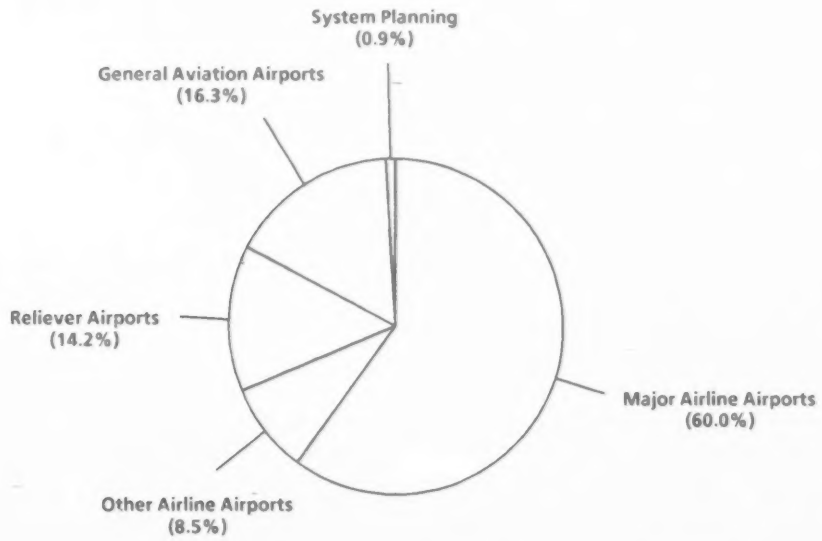
h. Other general aviation airports are all other airports handling nonscheduled flights.

i. Negligible.

ments at general aviation and reliever airports in cities with major hub airports have catered to the expansion in general aviation flying in those cities but have not markedly reduced the peaking in airline flights that causes the major delays at commercial airports.

Congestion results when more aircraft seek to land or take off than an airport can handle. At most airports, this excess demand is confined to peaks reflecting preferred travel times. Even high levels of use of airline airports by smaller aircraft in off-peak hours need not add to delays of airline aircraft or passengers. Since runways at most airports are crowded only during relatively short peaks, much of the nonscheduled flying that supplements the national system is as likely

Figure 6.
Recipients of New Federal Airport Grants Approved From 1983 Through 1987



SOURCE: Congressional Budget Office, from Federal Aviation Administration data.

to operate from the airline airports as from the relievers. The 50 largest airline airports, for example, which handle nearly 80 percent of airline flights nationwide, also handle as many general aviation trips as the busiest reliever airports serving 21 cities. Federal aid for these so-called reliever airports is in many cases not coping with peak-period traffic overflows from main airports, but is supporting separate, local, demands for sport, recreation, and travel.

The Air Traffic Control System

The air traffic control system sets the order in which aircraft take off and land at major airports and determines their speed and altitude in flight. While some delays and congestion may arise from bad weather and airline scheduling practices, the proper functioning of air traffic control is critical to avoiding long-term systematic congestion in air transportation. In assessing air traffic control, two conclusions emerge. First, modernization is overdue. Second, poor pricing of federal aviation services results in poor use of aviation infrastructure capacity.

Modernization. Updating the air traffic control system will approximately double its productivity, but will not necessarily add to FAA's capacity to relieve air traffic congestion.

Annual outlays for investment and research by FAA averaged $300 million from 1971 to 1983, representing a steady decline in real terms. By the early 1980s, equipment breakdowns and outmoded traffic handling systems had reduced the capacity of the national airway system and were creating work overloads for controllers. During the controllers' strike protesting these conditions in 1981, three-quarters of the controllers were fired. For the next two years, air traffic control was able to function only by administratively limiting the flow of traffic into the 22 busiest airports. These restrictions were lifted in 1983. Inadequacies in the equipment and persistent shortages of controllers continue to hamper air traffic. The controller work force remains about 5 percent below prestrike levels. The FAA has plans to achieve minimum staffing that would provide full levels of performance by the end of 1988 and to hire former military controllers to ease the shortage.

In 1982, the Congress approved FAA's plan to automate and consolidate air traffic control. The National Airspace System (NAS) plan was projected to lead to productivity gains that would allow controllers to double or treble the flights they could handle. Mostly for technical reasons, the NAS plan is running about five years behind schedule (FAA has been directed to prepare a comprehensive plan for carrying out the NAS project).[7] FAA's latest schedule calls for completing modifications of the computer system that will help give warning of impending midair collisions involving uncontrolled traffic in the vicinity of major airports (if aircraft are fitted with altitude-reporting equipment) by 1991. Nevertheless, overall completion of major components is not projected before the late 1990s.

CBO's evaluation of the plan showed it to be a sound investment, with an expected rate of return--after taking into account a wide range of risks, including possible implementation delays and cost overruns--of about 14 percent.[8] But although the plan will eventually solve the problems of inadequate equipment and controller shortages, it will not necessarily add greatly to the capacity of air traffic control. Ninety percent of the benefits of the NAS plan lie in the productivity-related cost reductions it affords: FAA's cost in handling any given level of traffic will be lower by about 30 percent because of lower costs for staff and equipment maintenance. But the automated system will need to be expanded to provide extra capacity for growth in the volume of air traffic.

Pricing. The dedicated taxes paid by aviation users do not ration the use of air traffic control capacity, nor do they reflect the cost of providing services. No premium is charged to passengers on peak flights; they pay more in federal taxes only if their fares are higher than those for off-peak trips. Consequently, passengers who would be willing to pay a premium for peak services may be crowded out by others for whom off-peak flights would be suitable. Moreover, the burden a particular flight places on the air traffic control system is unrelated to the taxes its passengers pay. Passengers who pay the same fare will pay the same tax, regardless of the air traffic control services needed

7. House Committee on Appropriations, *Department of Transportation and Related Agencies Appropriations Bill, 1989*, 100:2 (June 10, 1988).

8. Congressional Budget Office, *Improving the Air Traffic Control System: An Assessment of the National Airspace System Plan* (August 1983).

to complete their journeys safely. Finally, taxes paid per flight have not kept pace with traffic control costs. Salaries and other costs of providing federal services increased by 15 percent between 1983 and 1987, and controller workloads rose at about the same rate, but tax payments per flight for air carriers rose by only 5 percent.

THE OUTLOOK

Aviation in the 1990s will not resemble that of any previous decade. Deregulation of domestic airline services has altered every aspect of air transportation. For residents in most communities, airline travel is now less costly and more convenient than before, so it is reasonable to expect that traffic, and requests for airport expansion, will increase rapidly. While airline traffic has grown, general aviation has declined continuously, although growth in executive and business flying remains strong. Maintaining different airports for scheduled airlines and for nonscheduled business flying may become increasingly difficult. Airlines now base their networks around hub airports that provide flight connections between many origins and destinations. Hubbing helps to make better use of aircraft, and also provides a way of diffusing some airport congestion while improving air service at smaller cities. It has also made airport investment more risky and increased the peak loads on air traffic control.

Traffic Growth and Airport Expansion

FAA foresees growth in passenger travel averaging between 4 percent and 5 percent a year over the next 10 years.[9] Flights using the national air traffic control system are expected to grow at an average rate of around 2.5 percent a year, reflecting both extra airline flights and greater use of avionic equipment (required of aircraft using controlled airspace) by air taxis and general aviation. Even faster growth is forecast for major hub airports serving Denver, St. Louis, Washing-

9. Federal Aviation Administration, *FAA Aviation Forecasts, Fiscal Years 1987-1998* (February 1987).

ton, D.C., Phoenix, Philadelphia, Las Vegas, Charlotte, Orlando, Tampa, Salt Lake City, San Diego, and Memphis.

Traffic growth calls for expansion of airports. Overall, the National Plan of Integrated Airport Systems projects investment at airports of $24 billion over the next 10 years, about half of it for capacity expansion at either existing or new airports (see Table 13). Eighty percent of the needs for expanding capacity are foreseen to be at commercial airports, and major expansion projects (costing $20 million or more) during the 1990s are planned at airports serving 31 cities, for a total investment of nearly $2.5 billion. This expansion follows more than a decade when major projects were severely limited by considerations of noise and land use. Only about 8 percent of planned airport investment is for reconstruction, and an additional 3 percent is for other projects aimed at maintaining existing airport conditions. Almost half of projected investment at general aviation and reliever airports would be aimed at bringing airports in these categories up to FAA standards.[10]

General Aviation

Once thought to be closely tied to economic prosperity, general aviation has withered during the sustained economic expansion of the last six years. Sales of new general aviation aircraft have declined each year, and manufacturers' shipments are now only one-twelfth those of a decade ago. Two major manufacturers have suspended production of most piston-engined models. Since 1980, the number of private pilots has dropped by 10 percent, and the number learning to fly by 30 percent. Since 1980, hours flown on general aviation flights have fallen at an average annual rate of about 3 percent.

Most of the decline has been in personal flying. Business flying has continued its long-term growth of 2 percent a year, reflected in a 2 percent growth in general aviation flying in turbine-powered aircraft. Around one-third of all general aviation flying is now for business purposes, and is undertaken largely by the same groups who patronize

10. Federal Aviation Administration, *National Plan of Integrated Airport Systems (NPIAS) 1986-1995*, Report of the Secretary of Transportation to Congress Pursuant to Public Law 97-248 (November 1987).

commercial airlines' business flights. The concentration on business travel, and the increasingly sophisticated aircraft and equipment employed, indicate that airport use by nonscheduled business flyers is likely to remain strong at airline airports while it is likely to weaken at reliever and general aviation airports that offer a lower standard of facilities and do not provide connections with airline services.

TABLE 13. PROJECTED DEVELOPMENT COSTS FOR THE AIRPORT SYSTEM, BY PROGRAM OBJECTIVE, 1986-1995
(In billions of dollars)

Airport Service Level[a]	Maintain Existing Conditions		Achieve Recommended Standards		Relieve Congestion and Expand System			Total Investment
	Special Programs	Reconstruction	Upgrade for Growth	Upgrade for Current Users	Existing Airports	Airports for New Communities	New Airports for Existing Communities	
Commercial Airports								
Primary	0.3	1.2	2.1	2.8	7.1	0.1	3.3	17.0
Other	0.1	0.2	0.3	0.3	0.2	b	0	1.2
Subtotal	0.4	1.4	2.4	3.1	7.4	0.2	3.3	18.1
General Aviation								
Relievers	0.1	0.2	0.5	0.3	0.4	b	0.3	1.8
Other	0.2	0.4	1.4	0.8	0.5	1.1	b	4.4
Subtotal	0.3	0.6	1.8	1.1	0.9	1.1	0.3	6.2
Total, All Airports	0.7	2.0	4.3	4.2	8.3	1.3	3.7	24.3
Percent of Total Investment	3	8	18	17	34	5	15	100

SOURCE: Federal Aviation Administration, *National Plan of Integrated Airport Systems (NPIAS) 1986-1995* (November 1987).

a. See Table 12 for a description of the airport categories.

b. Less than $50 million.

Hubbing

Hubbing helps airlines to fill seats by attracting a large potential market. A nonstop flight serves only a single pair of cities; a flight with an intermediate stop serves travelers between three pairs of cities; and a second flight through the same intermediate point widens the potential market not merely to travelers between six pairs of cities but to all those traveling between ten pairs (that is, five cities taken two at a time). It is not uncommon for an airline to bring 20 flights into a hub to exchange passengers, and for these 20 aircraft and the passenger interchange among them to provide service between over 400 pairs of cities. Hubbing has been the source of much of the cost reduction in domestic air travel since deregulation, measured not only in fare reductions but in time savings from more frequent or more convenient flights.[11]

Hubbing may also lead to better use of the capacity of the existing airport system. Since the hub itself need not be a major traffic origin or destination, it can be established where capacity exists for the traffic interchange, rather than at an already busy airport. If congestion develops at a hub, traffic can flow over to new hubs. These smaller hubs raise the standards of service available at smaller airports far above what local traffic would allow. Thus the hubs at Raleigh and Charlotte, North Carolina, which developed to spread traffic from the much larger hub at Atlanta, Georgia, provide travelers to and from those cities with far wider choices of fares and flight times than they would otherwise have.

For the individual airport, however, hubbing greatly increases the peaking of traffic. To provide an effective interchange, flights must arrive and depart close together. For this reason, hubbing exposes individual airports to greater financial risk, since investments must be sized to a much larger level of operations than needed for local traffic and be closely tied to the commercial success of a single airline. The viability of investment at any hub can be suddenly altered by an airline bankruptcy or merger, or by an airline's reorganization of service patterns to improve profits. Since a single airline usually generates most of the peak, hubbing also tends to make airlines face

11. Changes in airline operations and their effects on airports are discussed in Congressional Budget Office, *Policies for the Deregulated Airline Industry* (July 1988).

the costs of peaking better than they do at other airports: the delays and confusion caused by overscheduling are directly reflected in the hub airlines' on-time performance records, rather than shared with many other carriers.

Hubbing represents a challenge to the outmoded air traffic control system. Two difficulties have arisen. First, the system has been slow to cope with the rapid buildup (and sometimes decline) of traffic at new hubs, and with the shift of traffic into new flight paths. One temptation is to reduce traffic to what the out-of-date traffic control system can handle, by such methods as allocations of arrival or departure slots. Second, airlines tend to open or close hubs without facing the costs imposed on the air traffic control system, since they are not charged a fee that reflects the use of traffic control towers and en route facilities.

OPTIONS FOR FEDERAL AVIATION POLICY

In dealing with aviation, federal policy can draw few lessons from the past. Simply spending more money on new facilities would probably not help to alleviate the widespread congestion, since additional traffic capacity depends not only on how many runways airports construct but also on how many aircraft can be safely handled by air traffic control. The physical capacity of the control system will probably continue to be limited for another 10 years until major components of the National Airspace System plan are completed. The prospect of little improvement in air traffic control, coupled with environmental objections to airport expansion, argues for a better system of managing demand so as to make the best use of existing capacity. The current system of user fees does not serve this purpose, and nothing in the current grants-in-aid program encourages airports to examine noninvestment solutions.

Two broad strategies may help in framing federal policies for a more efficient aviation infrastructure in the 1990s:

- Increasing the design capacity in the system to reduce peak-period congestion; and

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- Using idle, off-peak capacity to substitute for, or replace, some peak requirements.

Increase Design Capacity

The recent approval of extra funds for the FAA probably leaves little scope for speeding up completion of the National Airspace System. Progress will be largely determined by the time required to manufacture equipment and install it at air traffic control centers, and to hire and train controllers. But providing extra capacity may be possible through limited disbursements to airports that have enough air traffic control capacity to handle extra flights, or that will use the funds to improve ground handling and terminal areas. According to current projections, outlays of $1 billion a year for such a program over the next five years could be financed from the trust fund. Such additional spending would still leave an uncommitted balance in the fund (that is, a cash balance above commitments) of about $1 billion in 1993. This spending would provide about half the FAA-projected capacity investment at commercial airports shown in Table 13, although it is uncertain how many projects could meet the special terms for this aid.

One advantage of this option is that most of the programs are already in place, so that few additional uncertainties or delays would be introduced. Some earmarking of the additional airport grant money, or retargeting of existing grants, might be desirable. More could be dedicated to the capacity program, for example, if it was allowed to draw on funds otherwise available for grants to general aviation airports.

The disadvantages of the option are that major improvements in capacity would not occur until at least the mid-1990s when construction would be finished, and that it would not necessarily achieve the necessary flexibility in system capacity. Without improvements in the air traffic control system, relatively few airports are likely to gain significant capacity by developing runways and other ground facilities. Most airports, including the four that are subject to FAA slot allocations, have limited space for expansion. In addition, noise and land-use concerns have seriously limited major expansion projects in recent years. Even where expansion is feasible, it might result in excess capacity during off-peak periods; airlines might therefore be un-

willing to underwrite the investments in terminal buildings needed to match peak runway capacity because of the high costs involved, and because the new capacity would create opportunities for competitors to establish off-peak operations at major traffic points. Finally, new construction would take at least three to five years, and longer if projects proved to be controversial.

Use Off-Peak Capacity

This option would require airports to find ways of making off-peak flights attractive. A federal strategy to encourage this could be double-pronged:

- Eliminate grants for airport development; and
- Introduce peak-period prices for air traffic control.

Eliminating federal airport aid would require airports to consider all ways of providing extra traffic handling, including noninvestment options, from their own resources. The airlines, which ultimately underwrite airport expansion, would probably consider alternatives such as reorganizing their scheduling or establishing sub-hubs at uncongested centers. Demands for airport expansion would thus tend to reflect more closely what users themselves--the airlines--are actually willing to finance.

But some airport and airline responses to congestion may be unproductive. For example, congested airports sometimes dampen their traffic peaks by allocating landing or take-off times (slots), either through formal FAA procedures or through airline scheduling committees. These procedures arbitrarily divide capacity among existing carriers, with some carriers obtaining more slots than they need and others fewer.[12] Slot sales, permitted under FAA rules, allow some adjustments. But they may also be a barrier to competition. Airlines with excess slots can refuse to sell to a new airline wishing to enter service, and potential entrants may have difficulty in acquiring

12. The FAA allocates slots to carriers at John F. Kennedy Airport and La Guardia Airport (New York City), O'Hare Airport (Chicago), and Washington National Airport (Washington, D.C.).

enough slots to assemble an attractive hub service.[13] Airports may similarly discriminate against certain classes of traffic (for example, nonscheduled services), forcing them to operate only at unpopular times or at other airports, rather than allowing them to bid for slots. It is not clear to what extent airlines are able to buy or sell flight times on their own initiative without reference to airport or federal authorities. Repurchasing of landing rights gained through slot allocations or long-term use may be necessary if slot pricing is to be widespread.

Introducing peak-period prices for air traffic control would help to make better use of existing capacity by shifting some flights to off-peak hours. To the extent that airlines were willing to pay higher prices for peak flight times, the extra income could be used to build more capacity. If congestion continued in the face of peak prices, the FAA could be authorized to hire additional controllers and take other steps to increase short-term capacity.

Adoption of a national pricing system to allocate scarce peak-time airport and air traffic slots would ensure access to airports on the basis of willingness to pay. It would have the additional advantage of putting demands for expansion of the airport and air traffic systems to an economic test. So long as existing facilities are available at peak hours for less than the cost of providing additional capacity, the facilities are underpriced and likely to be overused. Using higher prices to allocate peak-time slots would show how much those slots are worth to the air carriers, and the extent to which new airport and airway capacity would be economically justifiable.

A disadvantage of the peak-pricing approach is that the FAA has had no experience with such a price system. A shake-out period might be needed before the system would begin to provide the correct market signals to airlines. Also, in order to retain some slots at peak hours for small carriers, it might be desirable to maintain a separate pool of slots for them.

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13. See, for example, Severin Borenstein, "On the Efficiency of Competitive Markets for Operating Licenses," Institute for Policy Studies Discussion Paper No. 226 (September 1985).

CHAPTER IV

WATER TRANSPORTATION

The water transportation industry has relied on federal support for a longer time, and to a far greater extent, than has any other transportation sector. This chapter reviews the federal role in the development of water transportation systems, examines the rates of return to current and proposed federal water transportation investments, and considers a number of alternatives that would focus federal aid on the most productive of these investments.

THE CHANGING FEDERAL ROLE IN WATER TRANSPORTATION

The federally supported water transportation system includes inland (and intracoastal) waterways and deep-draft ports and harbors.

Inland Waterways

The Army Corps of Engineers (the Corps) began building and maintaining the inland waterway system in 1824, when the General Survey Act directed the Corps to clear snags and sandbars from the Ohio and Mississippi rivers. Within 50 years, the federal government had assumed complete responsibility for constructing and maintaining nearly all waterways used for commercial navigation.[1]

The inland and intracoastal waterway system today consists of more than 21,000 miles of shallow-draft waterways (less than 14 feet) that have been improved by channel dredging or lock and dam construction. The primary commercial routes total about 11,000 miles. Traffic on inland waterways amounted to more than 210 billion ton-

1. Only the New York State Barge Canal system now lies outside the federal system.

miles in 1985, about 15 percent of all intercity freight movement that year.[2] Waterway commerce is heavily concentrated on a few segments: just 6 of the 28 segments that make up the inland waterway system carry 90 percent of all traffic (see Table 14). That traffic consists of tows carrying bulk commodities with low value-to-weight ratios--primarily coal, petroleum and petroleum products, sand and gravel, grain, and chemicals (Table 15).

Federal support for water transportation projects began as a way to promote both national economic development and national defense by linking the agricultural and industrial areas of the Midwest with markets in the population centers of the East Coast and abroad. The next hundred years saw the nation connected from coast to coast by a multifaceted freight transportation system. The system grew to include a trucking industry dependent on user-financed interstate highways, a network of private railroads, an airfreight industry, and numerous pipelines. These different modes now make up a substantially competitive and unregulated transportation market. With the notable exception of water transportation, these modes also operate without large subsidies from the federal government. As recently as 1982, federal subsidies to domestic inland waterway transportation totaled more than a fourth of that industry's costs, while subsidies to trucking constituted less than 5 percent of industry costs, and federal support for rail freight was minimal.[3]

Providing disproportionately large subsidies to one form of freight transportation in an otherwise competitive industry can lead shippers away from the mode that imposes the least cost on society as a whole. In 1978, the Congress sought to limit the economic distortions arising from federal support for water transportation by imposing limited user fees; these fees took the form of a tax on the fuel consumed by barges using most segments of the inland waterway system. The fuel tax was phased in over seven years, rising from 4 cents a gallon in 1980 to 10 cents a gallon in 1986. Under the 1986 Water Resources Development Act, the fuel tax will rise higher to 20 cents a gallon by 1995. The tax is expected to raise $49 million in 1988, and $325 million during the 1989-1993 period (see Table 16).

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2. Army Corps of Engineers, *Status of the Inland Waterways* (July 1987), p.11.

3. Congressional Budget Office, *Charging for Federal Services* (December 1983), p. 42.

TABLE 14. INLAND WATERWAY TRAFFIC, 1985

Waterway[a]	Thousands of Ton-Miles	Percent of Total
Ohio Brown	92,863,242	44.18
Ohio	44,806,898	21.32
Missouri-Ohio	15,589,939	7.42
Gulf Intracoastal	14,700,202	6.99
Mississippi River (Minneapolis to Missouri River)	13,023,160	6.20
Illinois	7,748,053	3.69
Tennessee	6,126,969	2.92
Black Warrior-Tombigbee	5,376,694	2.56
Arkansas System	1,485,206	0.71
Monongahela	1,280,501	0.61
Cumberland	1,247,759	0.59
Missouri	1,201,854	0.57
Columbia-Snake	1,051,217	0.50
Kanawha	900,049	0.43
Green-Brown	783,873	0.37
Alabama-Coos	512,655	0.24
Atlantic Intracoastal Waterway	346,244	0.17
Atchafalaya River	280,064	0.13
Tennessee Tombigbee	217,743	0.10
Red	196,805	0.09
Apalachicola-Chattahoochee-Flint	128,984	0.06
White	82,925	0.04
Kaskaskia	74,212	0.04
Allegheny	73,151	0.00
Ouachita-Black Rivers	49,239	0.02
Willamette	16,191	0.01
Kentucky	13,001	0.01
Pearl	308	[b]

SOURCE: Congressional Budget Office calculations using data from Army Corps of Engineers, *Status of the Inland Waterways* (July 1987).

NOTE: The data include only waterways covered by the Inland Waterways Fuel Tax.

a. Waterway definitions are those of the Army Corps of Engineers. See *Status of the Inland Waterways*.

b. Less than 0.01 percent.

Proceeds from the fuel tax are deposited in a trust fund, and can be used only as authorized by the Congress. The tax is intended to finance one-half of future inland waterway construction; the 1986 act authorized over $600 million from the Inland Waterways Trust Fund to pay half of the costs of seven new lock and dam projects. These seven would be the first federal waterway projects financed in part by waterway users. Because most of the funds authorized for waterway construction will go to ongoing projects, however, fuel tax receipts will equal only 21 percent of federal construction outlays between 1989 and 1993. And since the federal government will continue to pay for all operations and maintenance costs, fuel tax receipts will equal only 10 percent of total federal outlays for inland waterways during this period (see Table 16).

Deep-Draft Ports and Harbors

The federal government also subsidizes about 270 deep-draft port and harbor projects in the United States. Since 1824, the Corps has

TABLE 15. PRINCIPAL COMMODITIES IN INLAND WATERBORNE COMMERCE, 1985

Commodity	Percent of Total Traffic
Coal	27.5
Petroleum and Products	26.4
Nonmetallic Minerals and Products	14.2
Grain, Agricultural Products	13.2
Chemicals	7.6
Forest Products	3.3
Metal Ores	2.6
All Other	5.1
Total	100.0

SOURCE: Congressional Budget Office, from Army Corps of Engineers, *Status of the Inland Waterways* (July 1987).

dredged and maintained navigation channels, constructed general navigation works such as breakwaters and jetties, and (together with the Canadian government) built deep-draft locks on the Great Lakes.

In the past, the federal government has paid for nearly all the costs of building, operating, and maintaining general navigation projects undertaken by the Corps. Nonfederal interests have contributed only the lands, easements, and rights-of-way needed to construct general navigation works. In 1986, the Congress required nonfederal interests to share the cost of both the construction and the operation and maintenance of ports and harbors. The Water Resources Development Act requires the state or local government that sponsors a navigation project to pay a portion of initial dredging costs. The nonfederal share will be 10 percent for dredging depths between 14 and 20 feet, 25 percent for depths between 21 and 45 feet, and 50 percent for depths over 45 feet. This initial nonfederal share is to be paid during construction. After construction has been completed, the sponsor will have 30 years to pay an additional 10 percent of total construction costs. In general, this postconstruction payment is likely to impose no new burden on

TABLE 16. FEDERAL OUTLAYS AND REVENUES: THE INLAND WATERWAY SYSTEM (In millions of dollars)

	1988	1989	1990	1991	1992	1993	1989-1993
Total Outlays	516	569	601	620	640	667	3,096
Construction	239	280	300	306	313	326	1,526
Operations and maintenance	277	288	301	314	327	341	1,570
Fuel Tax Revenues	49	50	54	63	73	85	325
Tax revenues as a percentage of construction outlays	21	18	18	21	23	26	21
Tax revenues as a percentage of total outlays	9	9	9	10	11	13	10

SOURCE: Congressional Budget Office estimates.

most sponsors since the value of contributed lands, easements, and rights-of-way will count toward the added 10 percent share. The act does not require project sponsors to pay for subsequent maintenance dredging unless the channel depth exceeds 45 feet; for these deep channels, sponsors must pay 50 percent of maintenance costs. At present, only three ports have channels more than 45 feet deep.

The act makes explicit the right of a project sponsor to recoup its entire contribution by imposing port user fees. The act also imposes a federal fee for the use of those ports and harbors benefiting from federal operations and maintenance dredging. Most users will have to pay a Harbor Maintenance Tax of 4 cents for every $100 worth of cargo loaded or unloaded at these ports (cargo subject to the Inland Waterway Fuel Tax--most generally, cargo barged to a coastal port and reloaded for export--will be exempt from the Harbor Maintenance Tax). Proceeds from the tax are to be deposited in the Harbor Maintenance Trust Fund, from which the Corps is authorized to draw up to 40 percent of its outlays for the operation and maintenance of ports and harbors (see Table 17).

TABLE 17. FEDERAL EXPENDITURES AND COST RECOVERY FOR PORTS AND HARBORS (In millions of dollars)

	1988	1989	1990	1991	1992	1993	1989-1993
Total Outlays	558	594	622	644	668	696	3,224
Construction	128	147	156	158	161	168	790
Operations and maintenance	430	447	467	486	507	528	2,434
Harbor Maintenance Tax Revenues	152	171	187	202	220	238	1,018
Revenues as a percentage of O&M outlays	35	38	40	42	43	45	42
Revenues as a percentage of total outlays	27	29	30	31	33	34	32

SOURCE: Congressional Budget Office estimates.

WATER TRANSPORTATION ACHIEVEMENTS AND OUTLOOK

Between 1976 and 1986, no omnibus water resources legislation was enacted while the Congress worked toward the consensus on cost sharing in water resources that is reflected in the 1986 Water Resources Development Act. The Congress is now able to consider a variety of new construction projects to cope with the principal problems of the water transportation system.

Inland Waterways

Most new construction requests for the inland waterway system will be designed to cope with the problems of aging and congested facilities. Over the last 25 years, traffic on the inland waterways has tripled; it grew faster than GNP until 1972, and has mirrored GNP growth since then. With traffic growth has come congestion. Delays on the Ohio and upper Mississippi rivers, which have the smallest locks but carry the most traffic, averaged 23 minutes per tow in 1986. Delays were much shorter on both the lower Mississippi River (which, though heavily traveled, has newer, high-capacity locks) and the Atlantic Intracoastal and Mobile River waterways (which carry the least traffic). A recent Corps of Engineers study concludes that, despite these delays, inland waterway traffic will grow between 0.9 percent and 2.0 percent annually for the next 10 years.[4] This traffic will travel through facilities whose average age is increasing: by the early 2000s, nearly half of the 225 commercial locks and dams will exceed their 50-year economic life. Since good maintenance can extend lock and dam life, however, the Corps has concluded that only 56 locks will need major rehabilitation or replace-ment within the next 15 years.[5]

The Corps estimates that completing the 17 inland waterway projects in its current construction program will require further appropriations of $5.4 billion by the year 2000. Under current policies, federal outlays for new construction on inland waterways will be $280

4. Army Corps of Engineers, *Status of the Inland Waterways* (July 1987), p. 31.

5. Army Corps of Engineers, *National Waterways Study* (January 1983).

million in 1989 and $1.5 billion over the 1989-1993 period. Operations and maintenance outlays for inland waterways will total $288 million in 1989 and $1.6 billion in the five years from 1989 through 1993.

Ports and Harbors

Under current policies, about 75 percent of federal spending for ports and harbors will be devoted to routine maintenance dredging. Federal maintenance outlays for ports and harbors are expected to be $447 million in 1989 and $2.4 billion over the 1989-1993 period. In addition, federal investment in new port and harbor projects will be $147 million in 1989 and $0.8 billion between 1989 and 1993, much of it for channel deepening and widening. This focus follows from the increasing importance of large ships in the world fleet: the proportion of ships greater than 100,000 deadweight tons rose from 35 percent in 1980 to 60 percent in 1985.[6] The 1986 Water Resources Development Act authorizes the Corps to dredge two ports to the 50-foot depths these larger ships require.

Rates of Return

No study has been made of the rates of return that would be realized from the water transportation construction projects noted above. Some indirect evidence is provided by the Corps's benefit-cost studies of past projects, which show wide variation in the rates of return to water resources projects undertaken by the Corps. For example, the water resources projects requested by the Corps in the 1986 budget included 10 with net present values exceeding $1 billion and 14 with negative net present values.[7] The results may be a little more consistent in the future, since the current Administration will request funds only for projects that have benefit-cost ratios greater than one at a 10 percent interest rate.

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6. Department of Commerce, Maritime Administration, *A Report to Congress on the Status of Ports and Harbors* (1986).

7. Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986).

While this policy sounds promising, the credibility of Corps benefit-cost studies has been challenged repeatedly over the years. Examples of overoptimistic Corps benefit-cost studies are legion. The Tennessee-Tombigbee Waterway offers one recent example. When the project was first authorized, the Corps estimated that benefits would be 1.6 times greater than project costs. Much of the benefits were to come from transportation savings on annual cargo that was projected to reach 29 million ton-miles by 1991.[9] In 1987, however, only 4.1 million ton-miles of cargo moved on the waterway. Even if traffic growth on the waterway continues at the nearly 14 percent rate experienced since it was completed two years ago, annual traffic will not reach 29 million ton-miles for another 15 years.[10]

At a minimum, the case of the Tennessee-Tombigbee Waterway illustrates the uncertainty inherent in forecasting waterway traffic patterns and thus the benefits from future construction. More important, however, it may be symptomatic of methodological flaws both in the forecasts and in the way the benefits are measured. To forecast traffic on proposed waterways, the Corps conducts "shipper interviews" in which it queries large shippers about the amount of cargo they might move along a proposed waterway. While shippers have information that is relevant, they may tend to overstate the potential traffic on a project, particularly since waterway improvements are provided free of charge.

Even if traffic could be forecast with reasonable certainty, however, the Corps's current benefit-cost techniques would not allow a proper evaluation of the transportation cost savings associated with that traffic. The Corps measures transportation cost savings as the difference between the cost of barge traffic and the cost of shipping on some other mode (principally rail). While this correctly measures savings to shippers, it overstates the resource savings to society. Since rail rates often exceed long-run marginal costs, waterway transportation benefits measured as the difference between those rates and water transport charges reflect, in part, transfers of income from rail operators to shippers, not real resource savings to society as a whole.

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9. See General Accounting Office, "To Continue or Halt the Tenn-Tom Waterway? Information to Help the Congress to Resolve the Controversy" (May 15, 1981), pp. i-v.

10. Army Corps of Engineers, *Waterborne Commerce Statistics* (preliminary report, 1987).

Despite their flaws, these benefit-cost studies at least provide some indication of the returns to new water transportation investments. In contrast, there have been no such studies measuring the return associated with routine operations and maintenance dredging of ports and harbors. Some indirect evidence is provided by the data in Table 18 on operations and maintenance (O&M) outlays.

The data vividly illustrate the economies of scale that characterize dredging costs. Between 1979 and 1984, federal O&M expenditures for all ports averaged only $0.22 per ton, far less than one-tenth of 1 percent of the average value of cargo shipped. But the range of outlays varied from $0.17 at large ports to $0.50 at medium ports and $11.68 at small ports. By itself, of course, this information tells little about the return to spending in each class, since the value of shipping may exceed these O&M costs even at the smaller ports. However, at 38 of the deep-draft projects maintained by the Corps, no commercial cargo at all was handled in 1986. The benefits from federal dredging of these harbors accrued only to the fishing industry and recreational boaters. Furthermore, at five other ports, federal O&M expenditures averaged more than $115 per ton of cargo handled, or more than 25 percent of the average value of cargo shipped in U.S. ports. Unless

TABLE 18. FEDERAL PORT OPERATIONS AND MAINTENANCE OUTLAYS PER TON OF CARGO, 1979-1984
(In 1985 dollars)

Ports	Average	Minimum	Maximum
All Ports	0.22	0.001	270.25
Large Ports (More than 10 million tons per year)	0.17	0.001	0.99
Medium Ports (100,000 to 10 million tons per year)	0.50	0.001	23.30
Small Ports (Less than 100,000 tons per year)	11.68	0.050	270.25

SOURCE: Calculated by Congressional Budget Office using data from Army Corps of Engineers.

these ports specialized in cargo with extremely high value-to-weight ratios, the return to O&M at these ports would appear to be quite low.

POLICY OPTIONS FOR WATERWAYS AND PORTS

This section considers two options designed to focus water transportation investments on those projects that provide the greatest return to commercial navigation. Both options would increase the role of the market in choosing priorities for the nation's water transportation investments. One would increase user fees on federally supported navigation projects, and the other would turn over to states and localities all responsibility for the nation's public water transportation investments.

Increase User Fees for Federally Supported Commercial Navigation Projects

Imposing user fees that recover the full cost of federal operations and maintenance outlays for commercial navigation projects would work to increase the efficiency of these investments in a number of ways. First, shippers who benefit from federal navigation expenditures would press only for those projects where benefits would exceed the fees they would have to pay. Second, reducing subsidies to water transportation would improve the allocation of private resources, since choices among modes of freight transportation would be based on the true resource cost to society rather than on the degree of federal subsidies provided to each mode. Finally, user fees would encourage the more efficient use of existing capacity, thus reducing the need for new construction to overcome congestion (as on the inland waterway system).

The effects of user fees on efficiency would depend in large measure on the extent to which the fees were imposed on a systemwide or on a segment-specific basis. Since costs vary dramatically both for inland waterways and for ports, systemwide fees would offer far weaker incentives for cost-effective navigation investments. For example, the data in Table 18 indicate that a systemwide fee of $0.22 per ton would recover all federal O&M outlays for ports and harbors.

This fee would be far less than one-tenth of 1 percent of the average value of cargo shipped; it would also be small relative to other charges now paid by shippers and carriers--including wharfage, dockage, stevedoring, and harbor transfers--which averaged $16 a ton in 1981.[11] Such a fee would put little pressure on even the most inefficient ports.

Port-specific fees, on the other hand, would quickly expose the less efficient ports. For small ports, recovering federal O&M outlays would require added user fees of more than $11 a ton; at five small ports, user fees would exceed $100 per ton--about 25 percent of the value of the cargo handled at all U.S. ports. At medium-sized ports, an added fee of $0.50 per ton would be needed. This fee would increase existing port fees by about 3 percent for containerized cargo, 12 percent for grain, and 23 percent for coal. For large ports, an average fee of $0.17 per ton would add less than 1 percent to current port fees for containerized cargo, 3 percent for grains, and 5 percent for coal. The increase in the cost of delivered cargo would be much less, of course. For medium-sized ports, for example, a fee of $0.50 per ton would add less than 1 percent to the cost of coal delivered to European ports.[12]

The difference between systemwide and segment-specific fees would be equally dramatic on the inland waterway system. The cost of federal O&M on the inland waterways ranged from $0.00047 per ton-mile to about $0.95 per ton-mile in 1985 (see Table 19). A systemwide fee of $0.00161 per ton-mile would recover all federal O&M costs, but would do little to ration use of the system. One study of segment-specific fees, however, found that fees to recover even 50 percent of federal outlays would close 4 out of 12 waterway segments for lack of traffic. Moreover, such cost recovery would make congestion-related new construction unnecessary for 25 years.[13]

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11. The data on port charges used throughout this report come from the Senate Committee on Environment and Public Works, *Committee Report 97-301, to Accompany S. 1692* (November 1981).

12. See Energy Information Administration, *Quarterly Coal Report*, and Maritime Administration, *Commodity Yearbook*.

13. Department of Transportation, *Inland Waterway Taxes and Charges* (February 1982).

TABLE 19. TRAFFIC AND OPERATIONS AND MAINTENANCE OUTLAYS ON THE INLAND WATERWAYS SYSTEM, 1985

Waterway[a]	Thousands of Ton-Miles	O&M Outlays in Thousands of Dollars	O&M Outlays in Dollars per Ton-Mile
Pearl	308	293	0.95130
Kentucky	13,001	1,610	0.12384
Ouachita-Black Rivers	49,239	4,084	0.08294
Atchafalaya River	280,064	19,636	0.07011
Apalachicola-Chattahoochee-Flint	128,984	8,468	0.06565
Allegheny	73,151	4,030	0.05509
Atlantic Intracoastal Waterway	346,244	12,908	0.03728
Tennessee-Tombigbee	217,743	8,114	0.03726
Willamette	16,191	510	0.03150
White	82,925	2,058	0.02482
Kaskaskia	74,212	1,784	0.02404
Arkansas System	1,485,206	21,809	0.01468
Alabama-Coos	512,655	5,214	0.01017
Kanawha	900,049	7,045	0.00783
Red	196,805	1,538	0.00781
Monongahela	1,280,501	9,676	0.00756
Cumberland	1,247,759	9,424	0.00755
Missouri	1,201,854	6,570	0.00547
Columbia-Snake	1,051,217	5,608	0.00533
Mississippi River (Minneapolis to Missouri River)	13,023,160	50,708	0.00389
Green-Brown	783,873	2,155	0.00275
Black Warrior-Tombigbee	5,376,694	12,559	0.00234
Gulf Intracoastal	14,700,202	27,152	0.00185
Tennessee	6,126,969	9,755	0.00159
Illinois	7,748,053	11,060	0.00143
Ohio	44,806,898	38,446	0.00086
Missouri-Ohio	15,589,939	12,188	0.00078
Ohio-Brown	92,863,242	44,032	0.00047
Average	7,506,326	12,087	0.00161

SOURCE: Congressional Budget Office, from Army Corps of Engineers, *Status of the Inland Waterways* (July 1987).

NOTE: Data include only waterways covered by the Inland Waterways Fuel Tax.

a. Waterway definitions are those of the Army Corps of Engineers. See *Status of the Inland Waterways.*

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The sharp difference between systemwide and segment-specific fees reflects the large economies of scale in shipping. On the inland waterways, the 7 lowest-cost segments carry 90 percent of the traffic. Similarly, the 10 largest ports moved over 45 percent of the cargo handled in 1985. A systemwide fee would therefore be close to the segment-specific fee that is needed to recover costs on the least expensive segment. It would, however, have little effect either on congestion or on pressure to continue spending on the highest-cost, least efficient segments.

Proponents of continued subsidies for commercial navigation have argued that subsidies are needed to maintain the nation's competitiveness in international trade. Both foreign and domestic commerce could be subject to the fee, however. If systemwide fees were imposed, they would be unlikely to reduce significantly the amount of cargo handled. If segment-specific fees were used, the vast majority of traffic would still be subject only to small fees, while some that now use inefficient ports would be redistributed to other ports and transportation modes.

Proponents of federal subsidies also note that some subsidies are provided not to benefit commercial shipping but to promote regional economic development. User fees would remove this tool of regional economic development. At present, this may not be an issue; current Corps policy is to recommend the construction only of projects that offer national, not simply regional, economic benefits.

Withdraw Entirely from the Provision of Water Transportation Services

Rather than assume responsibility to provide needed water transportation investments and then recoup the cost through user fees, the federal government could withdraw entirely from this area and allow nonfederal interests to assume control over all water transportation projects.

This option would be most applicable to ports, where there is no strong economic rationale requiring federal support for commercial navigation. The port developer can easily capture the benefits of port construction projects since those projects provide services to a clearly

identifiable set of beneficiaries. Equally important, the port can make those services available only to those who pay port charges (as, indeed, many ports now do in order to recover the costs associated with nonfederal port improvements). Information given earlier about the amount of federal port expenditures as a percentage of already existing nonfederal user fees suggests that ports handling the vast bulk of the nation's trade could continue to make these improvements and recover their costs through user fees without affecting traffic. At other ports, projects would not be undertaken because they would not be cost-effective. Finally, under this option the largest, low-cost ports would not have to subsidize high-cost ports as they do under the current Harbor Maintenance Tax.

The potential effect of this option on the efficiency of port investments can be seen in the response of local governments to the limited cost-sharing introduced by the 1986 Water Resources Development Act. Table 20 shows four cases in which cost-sharing led local officials to reduce the size of the dredging projects they had requested by 25 percent to 83 percent. Since local authorities are authorized to recoup their cost share through user fees, the fact that they requested smaller projects indicates that they believed the larger projects would not generate commercial benefits at least as great as their costs.

This option has two drawbacks. First, it requires the federal government to eschew the use of port development as a tool of regional economic development. Second, it requires ports to incur all the risks associated with port development. This second drawback might be overcome if the federal government paid initial construction costs and then recouped those costs through user fees, thus spreading the risk of bad forecasts over all ports.

Ending federal involvement in water transportation projects would be far more problematic for inland waterways, since project developers would often be unable to capture the full returns to their investments. A case in point would be a downriver state contemplating the expansion of a lock now working at capacity. Since the traffic flowing by the downstream state would depend on the lock capacity of upstream states, the downstream state's return on an investment in a

TABLE 20. EFFECT OF COST-SHARING ON HARBOR IMPROVEMENTS

Improvement Project	Improvements Without Cost-Sharing	Improvements With Cost-Sharing
Baltimore Harbor	Deepen from 42 feet to 50 feet at a total cost of $387 million	Deepen from 42 feet to 50 feet but reduce channel widths in some cases from: 1,000 to 800 feet; 800 to 700 feet; 600 to 400 feet Construction cost savings: $81 million or 21 percent
Norfolk Harbor	Deepen from 45 feet to 55 feet at a total cost of $321 million	Deepen outbound channel only from 45 feet to 50 feet; defer some project elements Construction cost savings: $273 million or 85 percent
Mobile Harbor	Deepen from 40 feet to 50 feet at a total cost of $512 million	Deepen channel to 45 feet Construction cost savings: $431 million or 84 percent
Lower Mississippi River Ship Channel, New Orleans/Baton Rouge	Deepen Mississippi River from 40 feet to 55 feet for 252 miles at a total cost of $486 million	Deepen Mississippi River to 45 feet; shorten project length by 52 miles Construction cost savings: $340 million or 70 percent

SOURCE: Congressional Budget Office, from Army Corps of Engineers.

higher-capacity lock would depend on whether upstream states also invested in higher-capacity locks. Thus, in contrast to federal investment decisions that can consider efficiency on the waterway system as a whole, states might be held hostage to the investment decisions of their neighbors.

CHAPTER V

WASTEWATER TREATMENT

The 1972 Clean Water Act (CWA) gave the federal government substantial new responsibilities, both regulatory and financial, in improving water quality. While significant progress toward water quality goals has been made since then, serious water pollution problems remain. This chapter examines several options that the federal government might pursue to meet those challenges.

THE CHANGING FEDERAL ROLE IN WATER POLLUTION CONTROL

Until 1972, responsibility for controlling water pollution lay almost exclusively in the hands of state and local governments. The federal role was limited largely to performing research and development, and to providing technical and financial assistance to those municipalities that chose to build wastewater treatment facilities. Federal financial assistance came in the form of matching grants that covered between 30 percent and 50 percent of the costs associated with building municipal wastewater treatment plants. The federal presence was much less than these matching rates indicate, however, for appropriated funds were always a fraction of the amount that would have been needed to assist all communities that wished such grants. Further, the federal government made no attempt to determine the level of wastewater treatment that was appropriate for each community.[1]

Relying solely on states and localities to set and enforce water quality standards failed to stem the degradation of the nation's waterways, and in 1972 the Congress adopted a fundamentally different

1. A detailed history of the federal role through 1986 can be found in Environmental Law Institute, *The Law of Environmental Protection* (New York: The Institute, 1987); the 1987 Clean Water Act Amendments are discussed in Bureau of National Affairs, *Environmental Reporter*, vol. 18, no. 19 (1987), Part II.

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approach to controlling water pollution. To achieve the new goal of "fishable and swimmable" waters nationwide, the Federal Water Pollution Control Act of 1972, also known as the Clean Water Act, required the Environmental Protection Agency (EPA) to promulgate nationwide minimum standards for municipal and industrial wastewater treatment. These standards were to be technology-based; in other words, they were to specify precise end-of-the-pipe treatment techniques for the various sources of pollution. Municipal wastewater treatment facilities were required to provide at least "secondary" treatment--which means, most generally, removing at least 85 percent of conventional pollutants.

To help localities comply with the new requirements for municipal wastewater treatment plants, the act dramatically expanded the federal role in financing these facilities: the federal matching rate for local wastewater treatment construction costs was increased from 50 percent to 75 percent, while annual construction grants appropriations rose fivefold between 1972 and 1977. The Congress stated then, and has reaffirmed since, that the expanded federal presence was to be temporary: the new construction grants program was to be a bridge to an era in which all polluters, whether industrial or municipal, would be treated alike, and those who generated wastewater would pay for its treatment.

In 1981, the Congress began the process of returning to states and their localities complete financial responsibility for water quality management: authorization levels for the construction grants program were reduced by one-half, and the federal share of local construction costs was lowered to 55 percent for facilities built after 1984. The Clean Water Act Amendments of 1987 were designed to complete the transition to state and local self-sufficiency. Most important, the amendments require that the municipal construction grants program be phased out by 1991. In its place, the amendments establish a temporary federal program to provide seed money for state revolving loan funds (SRFs). For each dollar in federal "capitalization grants," a state must provide 20 cents to its SRF. SRF monies provide low-interest loans for local water pollution control efforts; loan repayments produce a self-sustaining source of money to finance local construction after the capitalization grants expire in 1994.

The capitalization grants are intended to provide localities easier access to the money they must borrow for water pollution control activities. While SRF monies may not be used for direct grants, they can be used in a variety of ways to lower the cost of municipal borrowing.[2] Among other things, states may loan SRF funds directly; use SRF funds as security for state borrowing, the proceeds of which are deposited in the SRF; and provide guarantees or insurance for loans that municipalities obtain elsewhere. Loans made or guaranteed by the SRF may vary to suit conditions in each community, subject only to these restrictions: the interest rate must be at or below the market rate; the life of the loan must be no more than 20 years; and repayment must be secured by a dedicated source of municipal revenue.

States will have to use SRF monies first to ensure that communities meet the enforceable requirements of the CWA, including the requirement that municipalities provide secondary wastewater treatment by July 1, 1988. After these requirements have been met, states may use the funds to carry out programs to manage pollution and to conserve estuaries.

ACHIEVEMENTS IN WATER POLLUTION CONTROL

By most accounts, significant progress has been made in controlling water pollution since 1972. This progress can be seen in the number of wastewater treatment plants that have been built: in 1977, only 37 percent of the wastewater treatment plants needed to meet the requirements of the CWA had been completed; by 1986, 90 percent of them had been built. Similarly, the proportion of the population served by secondary wastewater treatment facilities rose by 50 percent between 1972 and 1982. The effect of the CWA can also be seen in measurements of pollutants discharged and of water quality. Between 1972 and 1982, for example, the amount of wastewater released into waterways rose by nearly 7 billion gallons per day, yet the total amount of pollutants discharged remained essentially unchanged. And water quality has remained the same since 1972 for about two-

2. For a complete discussion of the permitted uses of state revolving fund loan monies, see Environmental Protection Agency, "Initial Guidance for State Revolving Funds" (January 1988).

thirds of the nation's streams, lakes, and estuaries, while improving about 10 percent of them (see Table 21). By 1986, three-quarters of the waterways were clean enough to support the uses that the states had set for them.[3]

THE OUTLOOK FOR WATER POLLUTION CONTROL

Federal policies toward wastewater treatment must address three emerging issues: the cost of constructing the remaining facilities needed to comply with the CWA; the rising cost of properly operating and maintaining those facilities; and the increasing role played by nonpoint sources of water pollution.

Construction Costs

The gains in controlling water pollution have been the result, in part, of real capital expenditures for public wastewater treatment facilities that have exceeded $90 billion since 1972. Meeting CWA requirements will still require significant future capital spending. EPA's most recent *Needs Survey*, for example, estimates that it would cost $60.2 billion, or $250 per capita, to build the facilities needed to treat the wastewater generated by the current population. Excluding those investments that would have been needed even in the absence of the CWA, the EPA estimates that the basic cost of complying with the act would be $33 billion, or $137 per capita, for the current population.[4] Table 22 shows estimated per capita wastewater treatment costs by state. Total capital costs for sewage treatment average $250 per capita; estimated costs are under $200 in 29 states, between $200 and $400 in 16 states, and over $400 in 5 states and the District of Columbia. Capital costs that might be thought of as attributable to the CWA average $137 per capita; these costs are under $100 in 20

3. See Environmental Protection Agency, *National Water Quality Inventory: 1986 Report to Congress* (November 1987); *1986 Needs Survey: Report to Congress* (February 1987); and "Study of the Future Federal Role in Municipal Wastewater Treatment," Report to the Administrator (December 1984).

4. Environmental Protection Agency, *1986 Needs Survey*. Excluded from the $33 billion amount are costs for rehabilitation/replacement of sewers, collector sewers, and combined sewer overflows--costs that are eligible for federal aid only under limited conditions.

TABLE 21. CHANGES IN WATER QUALITY, 1972-1982

Condition	Streams		Lakes		Estuaries	
	Thousands of Miles	Percent	Thousands of Acres	Percent	Square Miles	Percent
Improved	47	10.6	390	2.4	3,800	21.9
Constant	296	66.7	10,130	62.1	12,800	73.9
Degraded	11	2.5	1,650	10.1	560	3.2
Unknown	90	20.3	4,150	25.4	170	1.0

SOURCE: Congressional Budget Office, from Association of State and Interstate Water Pollution Control Administrators, 1984.

states, under $200 in 25 states, and between $200 and $400 in the remaining 5 states and the District of Columbia.

The estimates in the EPA *Needs Survey* reflect only those costs for which states and localities were able to provide the EPA with documentation showing that the spending would correct a water quality problem. Including the additional costs that states believe will have to be incurred would increase the total capital cost of wastewater treatment by 16 percent, from $60.2 billion to $69.7 billion. However, both the estimates provided by the states and those finally accepted by the EPA may overstate the money actually needed. The *Needs Survey* bases its cost estimates on localities' spending plans, which were developed on the assumption both that the federal government would pay for at least 55 percent of the construction costs and (in most states) that the state government would pay for an additional 5 percent to 25 percent of these costs. To the extent that this low local share would lead communities to build unnecessarily capital-intensive facilities, the EPA's cost estimates would be overstating the amounts actually needed.[5]

5. The effects of capital subsidies on local wastewater treatment spending are discussed later in the chapter.

TABLE 22. COSTS OF WASTEWATER TREATMENT FACILITIES NEEDED TO MEET CLEAN WATER ACT REQUIREMENTS FOR THE 1986 POPULATION, BY STATE

State	Total Cost (Millions of dollars)	Total Cost per Capita (Dollars)	Basic Cost (Millions of dollars)	Basic Cost per Capita (Dollars)
United States	60,222	250	32,992	137
Alabama	445	110	338	83
Alaska	112	210	94	176
Arizona	477	144	443	133
Arkansas	232	98	197	83
California	4,632	172	2,810	104
Colorado	72	22	68	21
Connecticut	1,041	326	413	130
Delaware	48	76	26	41
District of Columbia	245	391	245	391
Florida	2,352	201	1,439	123
Georgia	599	98	438	72
Hawaii	208	196	120	113
Idaho	118	118	87	87
Illinois	2,732	236	1,012	88
Indiana	1,485	270	395	72
Iowa	595	209	552	194
Kansas	367	149	288	117
Kentucky	1,140	306	574	154
Louisiana	796	177	526	117
Maine	267	228	186	159
Maryland	642	144	516	116
Massachusetts	3,733	640	2,053	352
Michigan	3,016	330	1,566	171
Minnesota	903	214	473	112
Mississippi	393	150	331	126
Missouri	925	183	768	152
Montana	39	48	21	26
Nebraska	120	75	85	53
Nevada	95	99	83	86
New Hampshire	735	716	306	298
New Jersey	3,290	432	2,167	284
New Mexico	56	38	33	22
New York	11,451	644	3,154	177
North Carolina	921	145	608	96
North Dakota	15	22	15	22
Ohio	3,096	288	1,994	185
Oklahoma	268	81	226	68
Oregon	727	269	345	128
Pennslyvania	1,453	122	844	71
Rhode Island	346	355	92	94
South Carolina	446	132	379	112
South Dakota	58	82	49	69
Tennessee	869	181	627	131
Texas	2,088	125	1,863	112
Utah	288	173	262	157
Vermont	144	266	69	128
Virginia	792	137	431	74
Washington	2,069	464	1,199	269
West Virginia	856	446	468	244
Wisconsin	1,107	231	808	169
Wyoming	24	47	23	45

SOURCE: Congressional Budget Office, using EPA and Census data.
NOTE: Basic cost excludes costs of rehabilitation or replacement of sewers, new collector sewers, and combined sewer overflows.

Operating and Maintaining Existing Facilities

As the stock of wastewater treatment facilities has grown, so has the relative burden of properly operating and maintaining these facilities. O&M outlays have risen steadily from one-third of all wastewater treatment spending in 1970 to more than one-half of all such spending in 1986.[6] Despite this increased spending, the correct operation and maintenance of existing facilities remains a major challenge. Recent studies suggest that between 15 percent and 35 percent of major sewage treatment facilities fail to comply with the effluent limitation in their operating permits because of deficiencies in this area.[7] EPA has found that better O&M can improve performance and also lower both capital and operating costs in the long run.

Pollution From Nonpoint Sources

To bring all waterways up to standard will require more than building new treatment facilities. The enforceable requirements of the CWA relate only to "point" sources of pollution--that is, pollution that enters the environment at discrete, identifiable locations such as industrial plants or municipal wastewater treatment facilities. Yet, recent water quality surveys show that, in many areas, most remaining water pollution stems from "nonpoint" sources such as agricultural runoff (containing fertilizers, pesticides, and animal wastes) and urban runoff (containing both human wastes and toxic metals such as cadmium and lead). EPA studies show that in the roughly 25 percent of waters that do not meet state use designations, nonpoint sources of pollution have been cited as the cause of water quality degradation in 76 percent of lake acres, 65 percent of stream miles, and 45 percent of estuarine waters. By contrast, point sources have been cited as the primary cause of pollution in 9 percent of lake acres, 27 percent of stream miles, and 34 percent of estuarine waters.[8] As the relative importance of nonpoint-source pollution rises, the cost-effectiveness of

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6. Estimated by the Congressional Budget Office from Census Bureau data.

7. See Environmental Protection Agency, *Environmental Progress and Challenges: An EPA Perspective* (June 1984); and General Accounting Office, "Costly Wastewater Treatment Plants Fail to Perform as Expected" (November 1980).

8. Environmental Protection Agency, *National Water Quality Inventory: 1986 Report to Congress.*

controlling pollution through the construction of new wastewater treatment facilities declines.

POLICY OPTIONS FOR WASTEWATER TREATMENT

The 1987 CWA Amendments again affirmed the Congress's commitment both to the water quality goals of the 1972 Clean Water Act and to the idea that the federal government generally should not bear the financial burden of municipal wastewater treatment. The discussion below examines several options through which the federal government might further those goals.[9] Each alternative is evaluated in terms of the effect it would have on the adequacy of state and local water quality investment, and on the efficiency of that investment. The options, which are not mutually exclusive, include:

- Cancel capitalization grants. The construction grants program could be permitted to expire as called for by current law, with no capitalization grants after 1988.

- Initiate regulatory reform. The amount of state and local capital investment needed to meet water quality standards could be reduced by using more flexible regulatory strategies.

- Reduce nonpoint-source pollution by making financial assistance for farmers contingent on adoption of pollution control practices and/or by imposing effluent fees. In many areas, the major impediment to achieving water quality goals comes from agricultural nonpoint sources. Pollution from such sources could be reduced by imposing effluent fees on the use of certain agricultural chemicals and by making price support payments and other financial assistance available only to those farmers that adopt "best management practices" to reduce nonpoint-source pollution.

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9. The options considered here do not include using effluent taxes to control point-source pollution. That policy will be evaluated in a forthcoming Congressional Budget Office publication.

Cancel Capitalization Grants

Current law authorizes appropriations for municipal wastewater treatment assistance of $10.8 billion for the 1989-1994 period. Of this amount, all but $0.4 billion could go to state revolving funds.[10] The President's 1989 budget proposed spending roughly half the amount, on the grounds that this would be sufficient to fund the federal share of all projects needed to meet the 1988 municipal compliance requirements and to complete all treatment plants started with federal funds. The President's proposal would have effects qualitatively similar to canceling capitalization grants and allowing the construction grants program to expire as called for by current law. Table 23 shows estimated outlays for both courses.

Federal Subsidies and the Level of Wastewater Treatment Investment. For a variety of reasons, ending federal subsidies for municipal wastewater treatment facilities would be unlikely to have much effect on the rate at which the nation adds to its public wastewater treatment capacity. First, various studies report that past federal funding for local wastewater treatment facilities has tended to supplant state and local spending, not supplement it.[11] For example, when federal funding increased following passage of the 1972 act, state and local government spending fell to little more than what was needed to match federal construction grants. Spending by states and local governments from their own resources fell 80 percent between 1972 and 1976, while federal spending quintupled to 90 percent of national construction outlays.[12] Ending federal subsidies would doubtless increase the share of wastewater treatment investment paid for by states and localities, but would not much affect the total amount of such investment. Indeed, the reduction in federal wastewater treat-

10. Authorization levels for capitalization grants total $8.4 billion for the 1989-1994 period. In addition, states may choose to receive as capitalization grants up to $2 billion of the amounts authorized to be appropriated during this period.

11. See James Jondrow and Robert A. Levy, "The Displacement of Local Spending for Pollution Control by Federal Construction Grants," *American Economic Review*, vol. 74, no.2 (May 1984); and Environmental Protection Agency, "Study of the Future Federal Role in Municipal Wastewater Treatment," Report to the Administrator (December 1984).

12. Environmental Protection Agency, "Study of the Future Federal Role in Municipal Wastewater Treatment," pp. 3-1 to 3-3.

TABLE 23. COMPARISON OF FEDERAL OUTLAYS FOR MUNICIPAL WASTEWATER TREATMENT UNDER THE PRESIDENT'S PROPOSAL AND UNDER A PROPOSAL TO CANCEL CAPITALIZATION GRANTS (In millions of dollars)

Projection	1989	1990	1991	1992	1993
Baseline	2,410	2,419	2,321	2,300	2,342
President's Proposal	2,378	2,218	1,794	1,430	1,173
Cancel Capitalization Grants	2,336	2,064	1,650	1,117	636

SOURCE: Congressional Budget Office.

ment funding that began in 1981 has, since 1983, been met by a sharp rise in state and local net investment.[13]

The federal government could also use a strong enforcement program in place of subsidies to see that the goals of the CWA are achieved. In fact, this has been an explicit part of federal policy since 1984. When federal construction grants rose during the 1970s, some state and local governments argued that they should not be required to meet the CWA deadlines until federal funds were available to share the costs of doing so. In 1984, however, the Congress passed the National Municipal Policy (NMP), which affirmed that all generators of wastewater were to be treated alike: states and localities, like all other polluters, were responsible for meeting CWA requirements regardless of the availability of federal funds. The NMP also set in place an enforcement mechanism to ensure that compliance would occur.

The relative merits of achieving clean water goals through enforcement rather than subsidies depend in part on one's view of the use that should be made of common waterways. Until 1972, there were no federal laws regulating the use of most waterways for disposing of wastewater. Unless prohibited by state or local laws, all wastewater generators thus had an implicit right to pollute common waterways. By establishing minimum wastewater treatment stan-

13. Congressional Budget Office, *Trends in Public Investment* (December 1987), p. 65.

dards, the CWA essentially changed the property rights associated with common waterways from those of a world in which communities enjoy the right to pollute to those of a world in which communities have the right to enjoy a minimum standard of cleanliness.

Federal Subsidies and the Efficiency of Local Wastewater Treatment Investments. For a variety of reasons, federal subsidies tend to result in less efficient state and local decisions about wastewater treatment investments. First, by lowering local construction costs, the subsidies give localities the incentive to build larger or more sophisticated treatment facilities than necessary. One study showed that both the construction and operating costs of wastewater treatment facilities built with subsidies from the federal construction grants program were higher than they would have been in the absence of such assistance.[14] The existence of federal subsidies also can cause localities to put off needed wastewater treatment investments in the hope of later qualifying for matching funds. Together, these problems contributed to the Congressional decision to reduce the federal matching rate to 55 percent and to the adoption of the National Municipal Policy.

Capitalization grants could have the same negative effects on efficiency as construction grants. The magnitude of the effects will depend, however, in part on the subsidy implicit in SRF loans. The subsidy is measured by the difference between the market interest rate and the SRF interest rate (assuming that all loans are for the maximum 20 years allowed by law). Table 24 shows the percentages of local costs that would be subsidized by various SRF loans. If SRFs made zero-interest loans, the subsidy provided by the SRF could easily be as large as is now provided by the construction grants program. At current interest rates, for example, a zero-interest loan would subsidize about 45 percent to 55 percent of local construction costs, depending on the creditworthiness of the borrower. A number of factors will tend to make SRFs somewhat more efficient than construction grants. First, many states are likely to use capitalization grants as a reserve fund against which further borrowing would be done. In most cases, the proceeds then would be lent to localities at near-market interest rates. Second, the terms of SRF loans, unlike the terms of construction grants, can be tailored to suit the financial

14. See Congressional Budget Office, *Efficient Investments in Wastewater Treatment Plants* (June 1985).

conditions of different localities. State officials could use this flexibility to offer higher subsidies for those local projects that they deem to be more efficient. Finally, states would be able to use some SRF monies for programs to control water pollution from toxic substances and nonpoint sources. In many areas, improving water quality by controlling these sources of pollution would be more cost-effective than additional investment in municipal wastewater treatment plants.

Ending the capitalization grants would increase the financial burden of state and local governments. This burden can be measured in a number of ways. Annual appropriations for the construction and capitalization grants together are authorized at $2.4 billion through 1991, after which federal assistance is to begin phasing out. If appropriated, this money would provide state and local residents with an annual grant averaging $9.79 per capita, ranging from $27.20 in Alaska to $4.94 in Arizona (see Table 25). On average, these grants

TABLE 24. GRANT EQUIVALENCE OF STATE REVOLVING FUND LOANS AT VARIOUS INTEREST RATES (In percents)

SRF Interest Rate	Bond Market Interest Rate												
	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	10	18	26	32	38	43	47	51	54	57	60	63
1	--	0	9	18	25	31	36	41	46	49	53	56	59
2	--	--	0	9	17	24	30	35	40	44	48	51	54
3	--	--	--	0	9	16	23	29	34	39	43	46	50
4	--	--	--	--	0	8	16	22	28	33	37	41	45
5	--	--	--	--	--	0	8	15	21	27	32	36	40
6	--	--	--	--	--	--	0	8	14	20	26	31	35
7	--	--	--	--	--	--	--	0	7	14	20	25	29
8	--	--	--	--	--	--	--	--	0	7	13	19	24
9	--	--	--	--	--	--	--	--	--	0	7	13	18
10	--	--	--	--	--	--	--	--	--	--	0	6	12
11	--	--	--	--	--	--	--	--	--	--	--	0	6
12	--	--	--	--	--	--	--	--	--	--	--	--	0

SOURCE: Congressional Budget Office, from Environmental Protection Agency, *Study of the Future Federal Role in Municipal Wastewater Treatment* (December 1984).

NOTE: The table assumes that a project is completely eligible for a loan or grant, that a loan covers all project costs, that a loan matures in 20 years, and that debt service is level.

TABLE 25. ALLOCATION OF ANNUAL FEDERAL WASTEWATER TREATMENT GRANTS, 1989-1991

State	Dollars per Capita	As Percentages of State and Local	
		Income	Taxes
United States	9.79	0.07	1.60
Alabama	6.70	0.06	0.98
Alaska	27.20	0.15	4.78
Arizona	4.94	0.04	1.00
Arkansas	6.69	0.06	1.34
California	6.43	0.04	0.88
Colorado	5.94	0.04	0.89
Connecticut	9.32	0.05	2.74
Delaware	18.82	0.13	1.89
District of Columbia	19.04	0.10	2.03
Florida	7.02	0.05	2.07
Georgia	6.72	0.05	0.87
Hawaii	17.70	0.12	2.90
Idaho	11.89	0.11	2.07
Illinois	9.50	0.06	2.09
Indiana	10.63	0.08	1.98
Iowa	11.52	0.09	1.62
Kansas	8.91	0.06	1.45
Kentucky	8.28	0.07	1.52
Louisiana	5.93	0.05	1.40
Maine	16.02	0.13	3.06
Maryland	13.15	0.08	1.55
Massachusetts	14.13	0.08	1.65
Michigan	11.41	0.08	1.52
Minnesota	10.59	0.07	1.18
Mississippi	8.33	0.09	1.40
Missouri	13.28	0.10	2.54
Montana	14.55	0.12	3.01
Nebraska	7.77	0.06	1.25
Nevada	12.37	0.08	2.96
New Hampshire	23.62	0.15	11.66
New Jersey	13.02	0.07	2.67
New Mexico	8.06	0.07	2.00
New York	15.08	0.09	1.45
North Carolina	6.92	0.06	1.06
North Dakota	17.55	0.14	4.57
Ohio	12.71	0.09	1.96
Oklahoma	5.93	0.05	0.97
Oregon	10.16	0.08	1.40
Pennsylvania	8.09	0.06	1.50
Rhode Island	16.72	0.11	3.13
South Carolina	7.36	0.07	1.20
South Dakota	16.83	0.14	7.64
Tennessee	7.34	0.06	2.16
Texas	6.65	0.05	2.15
Utah	7.68	0.07	1.28
Vermont	22.03	0.17	3.61
Virginia	8.58	0.06	1.30
Washington	9.46	0.06	3.71
West Virginia	19.73	0.19	4.09
Wisconsin	13.71	0.10	1.77
Wyoming	23.50	0.18	3.04

SOURCE: Congressional Budget Office from Census Bureau data.
NOTE: These figures assume federal appropriations of $2.4 billion per year.

would represent 0.07 percent of state personal income; in no state do the grants amount to more than 0.2 percent of income. To replace these federal funds, total state and local tax collections would have to rise an average of 1.6 percent. Taxes would have to rise the most in New Hampshire (11.7 percent) and the least in Georgia (0.9 percent).

Use More Flexible Regulatory Strategies

The CWA requires all point sources to meet minimum limits on pollution stemming from technology. States can set more stringent limits when necessary to meet state water quality goals. The EPA estimates that building the "advanced treatment" wastewater facilities needed to meet the goals of the CWA will cost up to $4.3 billion. More flexible regulatory strategies could eliminate the need for some of this capital spending and also reduce the cost of operations and maintenance at those plants that are built.

The most promising new regulatory regime involves point/nonpoint trading--allowing certain point sources to forgo further improvements in pollution control. In return, the point sources would finance and/or manage the carrying out of controls on nonpoint sources. Savings from such trading arise from differences in the cost of treating point and nonpoint pollution. Until now, water pollution control has concentrated on point-source investments. Since the unit cost of cleaning wastewater rises sharply as the treatment level is increased from secondary to advanced treatment, further improvements in water quality in many areas could be achieved more cheaply by adding nonpoint controls than by raising municipal treatment standards.

The total savings possible through such trading have not been estimated; its potential has been explored at only a few sites, but in each case the savings have been dramatic. Savings are most likely to arise in areas such as the Chesapeake Bay, where nonpoint sources contribute an estimated 67 percent of the nitrogen and 37 percent of the phosphorus that is deposited in the bay. An EPA study of one small drainage area in the Chesapeake found that reducing phosphorus loads by 25 percent would be 83 percent cheaper using non-

point-source controls than increasing treatment standards at the local sewage treatment plant.[15]

Similarly, the Dillon Reservoir in Summitt County, Colorado, achieved its goals for water quality by paying for the creation of settling ponds to control runoff from surrounding urban areas. These ponds cost less than a tenth of the amount that would have been needed to increase the reservoir's wastewater treatment capabilities.[16]

While these examples hold the allure of great savings, the potential for widespread use of point/nonpoint trading is unknown. The largest barrier to carrying it out extensively lies in a lack of the information needed to make such a strategy work.[17] The necessary information is of two kinds. First, a baseline estimate of current nonpoint-source pollution must be constructed. Moreover, since the effects of nonpoint sources vary widely with both precipitation and temperature, developing a baseline requires detailed monitoring of water quality over a number of years. Currently, such detailed monitoring of water quality has been done at only a few experimental sites. Second, water-quality managers lack good information on the effects of different nonpoint-source controls. Conservation tillage, for example, is a "best management practice" (BMP) for reducing nonpoint pollution from farms. Yet, a number of different techniques fall under the rubric of "conservation tillage." Further, the effect of these techniques varies significantly from field to field, depending on the nature of the soil, the contours of the land, and the distance to relevant surface water. Since the effects on water quality of conservation tillage have been studied only in a few situations, managers of water quality cannot predict with much certainty the consequences of adopting such practices on a widespread basis. Point/nonpoint trades based on carrying out conservation tillage (or any one of a number of BMPs) therefore will involve exchanging certain increases in point-source pollution for very uncertain decreases in nonpoint pollution.

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15. Industrial Economics, Inc., "Point/Nonpoint Trading to Reduce Phosphorus Loads to Chesapeake Bay," prepared for the Environmental Protection Agency, May 1987. This estimate did not include the cost of administering the program.

16. Skylonda Group, Inc., "Achieving Water Quality Standards with Non-point Source Trading: The Case of Dillon Reservoir," prepared for the Environmental Protection Agency, September 30, 1984.

17. See F.J. Humenik and others, "Pollution from Nonpoint Sources," *Environment, Science, and Technology*, vol. 21, no. 8 (1987), p. 741.

More data would not completely eliminate the uncertainty that accompanies point/nonpoint trades. Since nonpoint pollution varies from season to season and from year to year according to natural forces, some point/nonpoint trades would be effective only on average over a number of years. At any given time, pollution from nonpoint sources might be more or less than expected. Whether this variation was acceptable would depend on the particular pollutant involved and on the water quality of the relevant waterway.

In addition to point/nonpoint trading, lesser gains may be possible by issuing permits that would make greater allowance for the natural capacity of a body of water to purify conventional pollutants. Seasonal permits, for example, allow the level of pollutants in treated wastewater to vary with the season. In summer, stream flows are low and temperatures are high, reducing the natural ability of streams to cleanse themselves; maintaining a given level of water quality thus requires cleaner wastewater in summer than in winter. One study estimated that a seasonal permit system in North Carolina would save about $2.9 million a year in wastewater treatment costs.[18] As with point/nonpoint trading, however, only anecdotal, site-specific examples of the savings possible from the flexible use of permits are available. Moreover, many states already have some form of flexible permit issuance in place, so opportunities for further savings may therefore be limited.

Reduce Nonpoint-Source Pollution

In many areas, improving water quality requires limiting nonpoint-source (NPS) pollution. Recognizing this problem, the 1987 CWA amendments for the first time required that states establish NPS control programs. States must provide EPA with a list of waters that have not achieved water-quality goals because of NPS pollution, and by 1989 states must develop NPS management programs and formulate schedules for carrying them out. The amendments allow the greater of $100,000 or 1 percent of each state's construction grant allotment to be used for nonpoint-source control.

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18. For more detail on flexible permit issuance, see Congressional Budget Office, *Efficient Investments in Wastewater Treatment Plants* (June 1985), p. 62, and the sources cited therein.

This section evaluates two methods by which the federal government could buttress the states' NPS management programs. Both methods focus on agricultural activities, which are by far the greatest source of NPS pollution. For example, almost 70 percent of the nitrogen and phosphorus deposited each year in surface waters comes from farming.[19] The first option would make farm price supports and other assistance available only to farmers willing to adopt "best management practices" for NPS pollution control. The second would impose a fee on the use of certain agricultural chemicals in order to discourage their use.

The Food and Security Act of 1985 (Public Law 99-198) includes two provisions designed to reduce agricultural pollution. The first establishes a Conservation Reserve Program, under which the federal government will rent and take out of production 40 million to 45 million of the nation's most erodible acres. The other provision requires farmers of highly erodible land to adopt an approved soil conservation plan in order to qualify for financial assistance from any federal agricultural program, including commodity price supports, loans, and disaster assistance. The conservation plan must be adopted by 1990, and carried out by 1995.

The primary focus of both these measures is the control of soil erosion; the water-quality effects are secondary. Although sediment is a major contributor to NPS pollution, erosion is not the only factor. For example, when fertilizers are spread on clay soils, erosion rates may be low but chemical runoff rates quite high. Similarly, farmers who adopt conservation tillage to reduce soil erosion may try to offset potential reductions in yield by applying more fertilizer and pesticides to their fields; in this case, a successful soil erosion program may actually increase problems with water quality.

The provisions of the Food and Security Act would have a greater impact on water quality if federal farm payments were also made dependent on the adoption of BMPs for water quality. This requirement would be most cost-effective if imposed only on farms in those watersheds where nonpoint sources are the major impediment to further improvements in water quality.

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19. Gordon Chesters and Linda-Jo Schierow, "A Primer on Nonpoint Pollution," *Journal of Soil and Water Conservation*, vol. 40, no. 1 (January-February 1985).

The costs that this option would impose on farmers are difficult to assess, for the cost of switching to BMPs has not been well studied. Some studies, however, have found that many BMPs would be profitable for farmers. Some evidence indicates that farmers have not adopted them because information has not been available or because they are averse to risk.[20] This option also would raise administrative and enforcement difficulties, for it would require EPA and the Soil Conservation Service to agree on the nature of BMPs when the two objectives of soil conservation and water quality do not dovetail.

An administratively simpler approach would use taxes to discourage use of those agricultural chemicals that are most harmful to water quality. For example, a 10 percent tax on the sale of nitrogen and phosphorus would reduce consumption of these chemicals by about 3 percent. The revenue from this tax could be returned to the states to fund state NPS control programs. The chief virtue of such a tax, its simplicity, is also its principal flaw. Agricultural NPS pollution is a multifaceted problem, and agricultural chemicals contribute to water-quality problems in very disparate ways in various watersheds. Like all uniform national standards, the tax would cause unnecessary reduction in some places and too little reduction elsewhere.

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20. See Industrial Economics, Inc, *Point/Nonpoint Trading to Reduce Phosphorus Loads to Chesapeake Bay* (May 1987), prepared for the Environmental Protection Agency, Office of Policy, Planning, and Evaluation; and J.G. Konrad and others, "Nonpoint Pollution Control: The Wisconsin Experience," *Journal of Soil and Water Conservation*, vol. 40, no. 1 (January-February 1987).

CHAPTER VI

COMPREHENSIVE STRATEGIES

The preceding chapters have presented options for improving individual infrastructure programs. This chapter examines some proposals that would require a broader-based restructuring of federal programs. The proposals share one key feature: each would lower the boundaries between existing infrastructure programs and thereby increase competition among them for federal resources.

IS GREATER COMPETITION AMONG INFRASTRUCTURE FORMS DESIRABLE?

The arguments in favor of broadening the bases of federal infrastructure programs are twofold. First, successful infrastructure development increasingly requires planning for many forms of infrastructure. Allowing more explicit trade-offs between different kinds of infrastructure can lead to more cost-effective decisions about what to build and how to maintain it. Second, narrowly defined programs are less necessary and less useful than they once were, for the historical circumstances that prompted their establishment no longer exist.

Economic development officials recognize a growing need for greater coordination in planning among institutions and infrastructure sectors. The interaction between different infrastructure modes and the importance of a coordinated, comprehensive approach to infrastructure development can be seen most easily in local water supply and wastewater treatment policies. Since the price of water affects the amount of water used, it also influences both the wastewater treatment capacity needed and the amount of nonpoint-source pollution generated. Conversely, the price of wastewater treatment influences the amount of water that is used.

The need for similar coordination can be seen in a variety of transportation and environmental problems. Regional transportation plan-

ners, for example, will have to decide on a combination of aviation, rail, and highways to provide mobility and ease congestion; local transportation officials must relieve congestion through a combination of new or expanded roads, mass transit facilities, and nonstructural alternatives (such as increased traffic management, changes in car parking policies, and land use planning); and local economic development officials will have to coordinate the provision of both transportation and environmental infrastructure to serve local economic development. In each case, the efficient provision of one kind of infrastructure will depend on having coordinated policies for many kinds of infrastructure.

Federal infrastructure policies that give different subsidies to different modes may fail to promote the best investment choices for local infrastructure. For example, many localities have been unable to find projects worth financing with the federal mass transit formula grants to which they are entitled. At the same time, however, states and localities cannot receive federal matching grants for all of the highway and wastewater treatment investments that they would like to make. This mismatch between federal funds and local spending preferences could be ameliorated by federal programs that allowed more competition among projects in different modes.

Historical developments have made narrowly defined, categorical infrastructure programs less necessary than they once were. Some were designed, in part, to foster a competitive transportation network. The long-term federal policy sought to promote the economic viability of different transportation modes; competition among them was to ensure an efficient overall transportation system. In the short term, however, making these modes of transportation economically viable required regulations and subsidies specific to each, and made it desirable to create agencies and programs that could articulate and defend the interests of different transportation industries. These federal policies have borne fruit. The nation now has a comprehensive transportation system that is largely deregulated and competitive. Following the deregulation of air, truck, long-distance bus, and rail travel, the various modes compete for business on roughly equal footing, making different federal subsidies less necessary.

The arguments in favor of maintaining the current array of federal programs are twofold. First, federal matching grants are de-

signed in part to increase state and local infrastructure investment by correcting inefficiencies in private markets. Many kinds of infrastructure--the interstate highways, the national air traffic control system, inland waterways, and others--confer benefits on residents outside the jurisdiction providing a particular facility. When a community that pays for a facility can recover the cost of providing services to nonresidents (through user fees, for example), no federal intervention may be necessary. But when a community receives only a fraction of the benefits from a facility, yet must pay all of the associated costs, it will have no incentive to provide what is most beneficial for the nation as a whole. The federal government can encourage states and localities to make the appropriate infrastructure investments by paying that portion of state and local expenditures corresponding to the uncompensated benefits that spill over into neighboring jurisdictions.

The existence of this jurisdictional problem argues for continuing categorical grants that allow federal agencies to address the particular circumstances of each mode. A significant fraction of the traffic on the Interstate highway system, for example, moves between states; on the other hand, mass transit ridership, though often substantial, falls mainly within the political jurisdiction of metropolitan areas. To the extent that federal subsidies are intended to correct this jurisdictional problem, they should differ according to the characteristics of each infrastructure mode.

In this view, the benefits of broadening grant categories so that federal funds can be better tailored to local conditions must be weighed against the loss of federal ability to compensate for different effects in different jurisdictions. Yet, the current structure of categorical grants may actually have little effect on state and local infrastructure outlays. Many studies have concluded that federal subsidies mostly substitute for, rather than complement, state spending, because states tend to reduce their own spending in the subsidized areas.[1]

Narrowly defined federal grants also allow the Congress to define a different target population for each type of infrastructure. One pur-

1. For a review of these studies, see Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986), pp. 80-86.

pose of mass transit grants is to increase the mobility of the poor, while highway grants are intended to benefit all drivers, without explicit reference to income.

COMPREHENSIVE INFRASTRUCTURE OPTIONS

Competition among the different infrastructure modes can be increased either by (1) ceding to states and localities greater discretion in the use of federal infrastructure subsidies; or by (2) changing the manner in which the federal government allocates those subsidies. Options giving greater control over infrastructure outlays to states and localities would make such investment more efficient from the local perspective, but simultaneously would replace federal infrastructure preferences with state and local preferences. Options that would follow this approach include:

- Replace existing categorical grants with one or more block grants;
- Allow categorical grant recipients to "fine tune" their federal grants by trading in, on perhaps less than a dollar-for-dollar basis, funds from one infrastructure account for money in another account;
- Capitalize state revolving funds so states could use federal grants to lower localities' cost of borrowing for infrastructure investment; and
- Subsidize state and local governments' access to capital markets.

Options that would retain decisionmaking at the federal level include:

- Change the manner in which existing agencies evaluate and nominate infrastructure projects; and
- Create a new federal agency to rationalize federal investment choices in infrastructure.

Use Block Grants

States and localities would get the most control over federal infrastructure funds if those funds were made available as a single infrastructure block grant. Such a grant would provide the same subsidy to all state and local infrastructure outlays. At present, the federal share under categorical grants varies both within and between the infrastructure modes.

Allowing states and localities to allocate federal funds among infrastructure modes might lead to a more efficient set of projects: by virtue of their greater proximity to local problems, states and localities may be better able to choose among projects for which rates of return vary widely both by mode and by region. An example may be seen in highways: fixing all deficiencies on rural Interstates would have little or no economic value, while relieving congestion on certain urban arteries would have a high rate of return. Similarly, the per capita cost of building the wastewater treatment facilities mandated by the 1972 Clean Water Act would be higher in the coastal regions (where population concentrations are highest) than in the Midwest.[2] Moreover, the kinds of wastewater treatment facilities needed vary by region: a state such as Florida, with newer cities and a more rapidly growing population, would have to spend less to correct combined sewer overflows than would states such as Massachusetts and New Jersey. Given these regional differences, a more efficient set of infrastructure investments might result from state and local choices than from a standard pattern of federal subsidies.

Evidence as to changes that might follow from adopting a single infrastructure block grant can be found in the consolidation of several social welfare grants in the early 1980s.[3] States directed block grant funds less toward low-income populations and more toward the general population. If this were to occur under a general infrastructure block grant, one might see a shift away from mass transit toward other kinds of infrastructure that are less targeted to the poor. Indeed, the evidence in Chapter II suggests that current mass transit services

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2. See National Council on Public Works Improvement, *Wastewater Treatment* (May 1987).

3. See George Peterson, *The Reagan Block Grants* (Washington, D.C.: The Urban Institute, 1985).

ill serve the poor, and may be no more targeted toward them than are infrastructure services generally.

States also shifted funds toward programs that benefited rural areas more than did the categorical programs. This result could be partly avoided under an infrastructure grant by requiring states to maintain the current division of federal grants between rural and urban areas.

Consolidating categorical programs would raise a number of issues. First, a single infrastructure block grant would increase the amount of "fiscal substitution" that occurs with federal infrastructure grants--that is, federal funds would be more likely to supplant rather than supplement state and local infrastructure outlays. While current categorical grants allow significant amounts of substitution, it is not uniform among infrastructure modes.[4] By providing a smaller percentage of a larger spending category, a federal block grant for all infrastructure would make it easier for states and localities to substitute federal funds for their own resources. Indeed, the broader the block grant, the more the federal grant would resemble general revenue sharing, and the less it would encourage state and local spending on infrastructure relative to other investments. Thus, a block grant would be less efficient than categorical grants at increasing total infrastructure investment. Moreover, since a block grant would subsidize all modes at the same rate, it could not correct for jurisdictional problems that differ by type of infrastructure.

Moving from categorical to block grants might also change the political dynamics involved in getting approval for federal infrastructure outlays. When programs are very narrowly defined, their benefits redound to a relatively small constituency while their costs are spread among taxpayers generally; the particular merits of a program aside, interest groups representing program beneficiaries are likely to exert more pressure in support of the program than taxpayers generally are likely to exert in opposition to it. The more broad-based an infrastructure grant program, then, the easier it is to keep outlays under budgetary control. For this reason, supporters of narrowly de-

4. Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986), p. 80.

fined programs sometimes see a change to more broadly based grants as a prelude to cutting spending for their programs.[5]

Finally, state and local bureaucracies may have to be changed if block grants are to increase the efficiency with which federal grants are used. Most state and local infrastructure agencies have developed along the lines of the federal agencies that administer their grant programs. If the states and localities are to increase the efficiency of their infrastructure choices, they may need agencies that can make explicit trade-offs among investments in different modes.

Allow Transfers Among Infrastructure Accounts

Allowing recipients of categorical grants to transfer funds between infrastructure accounts would be a half step toward block grants. By enabling states to fine tune federal assistance at the margin, these trade-ins would have effects qualitatively similar, with a few exceptions, to those of block grants. Unlike block grants, however, trade-ins would maintain different matching rates on different modes. Grant recipients would have more influence over the level of spending in each account, but the effects on incentives of the various matching rates would be unchanged.

If the grants were traded in on a less than dollar-for-dollar basis, transfers among accounts would increase the effectiveness of federal spending (since states would transfer funds of their own volition) and also reduce the amount of spending. The available evidence suggests that states would be willing and able to trade in funds. Under a program operated by the Federal Highway Administration in the 1970s and early 1980s, which allowed states to trade in Interstate Highway funds in favor of other transportation projects, states generally eliminated highway projects with low or negative rates of return. If carried out on a broader scale, the long-term result of such a program would probably be the reallocation of resources from those programs with large unspent balances (such as mass transit) to programs on which state and local governments wish to spend more (such as airports).

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5. See Peterson, *The Reagan Block Grants*; and Robert Reischauer, *Fiscal Federalism and Grants-in-aid* (Washington, D.C.: The Brookings Institution, 1979).

A trade-in program would have important implications for discretionary and formula grants. Discretionary grants sometimes are provided under the assumption that formula grants are insufficient to satisfy the spending needs of a state or locality. Allowing a community to trade in formula money when it also received discretionary money would undo the purposes of the discretionary grant: if receipt of a discretionary grant led a community to trade in formula grant money, the discretionary grant would merely be substituting for the formula grant.

Capitalize State Revolving Funds

Capitalizing state revolving funds (SRFs) could give localities easier access to subsidized credit. SRFs could use the federal money to provide localities with low-interest loans; to collateralize further state borrowing, the proceeds of which would be used to make loans to localities; to purchase credit insurance for localities; and to provide guarantees for similar revolving funds set up by municipalities. Limits could be set on the form and purposes of the SRF loans. For example, the federal government could specify the types of projects that could be financed with SRF loans, set a maximum term for the loans, and require loan recipients to establish dedicated revenue sources for repayment of the loans.

In general, credit subsidies are substantively no different from direct matching grants. For example, a locality paying 8 percent interest on a $100,000 SRF loan would have the same annual outlay as if it received an outright grant for 20 percent of the $100,000 and had to borrow the remainder without subsidy at 11 percent interest. Table 24 (in Chapter V) shows the percentages of local costs that would be subsidized by various SRF loans.

Grant and credit assistance programs may differ, however, in the amount of aid that each provides to smaller, infrequent borrowers. While matching grants cover the same percentage of each recipient's costs, SRF loans that offered the same interest rate to all borrowers would provide higher implicit matching rates for those with the weakest credit ratings (and thus the highest rates were they to borrow in the market). In general, smaller and less frequent borrowers have lower credit ratings.

State revolving funds also could provide a more stable source of financing than does the existing grants structure. The stability of SRF financing depends on whether an SRF lends the amount of its capitalization grant directly to localities or keeps the money as a reserve against which it can borrow more money. The total volume of SRF lending would be most predictable if the capitalization grants were lent directly to localities. If the capitalization grants were used instead as collateral against further borrowing, the total volume of SRF loans would be larger but less stable, since the amount borrowed (and then lent) by an SRF would depend on changing credit-market conditions.

More stable long-term financing would allow states to make long-term plans in a more certain climate. Yet, the history of federal categorical programs shows that too much stability can have a price. There is evidence, for example, that the federal wastewater treatment grants encouraged some localities to postpone needed wastewater treatment projects until federal matching grants were available instead of addressing their needs promptly.[6] Localities might wait in like manner for infrastructure funding from the SRFs.

Subsidize Localities' Infrastructure Borrowing Costs

Three limitations of private capital markets now make the borrowing costs of state and local governments higher than they otherwise would be--the illiquidity of municipal bonds, the relatively high fixed costs of issuing debt in small quantities, and the uncertainty surrounding the creditworthiness of infrequent borrowers.

The heterogeneity of municipal bonds makes them relatively illiquid, and makes it difficult for investors to reduce their municipal bond portfolios before the bonds have matured. As a result, investors require an interest-rate premium to compensate them for accepting most of the risk associated with interest-rate changes that may occur before the bond comes to term. If investors could more easily resell the bonds whenever they wanted to reduce their participation in a market, they would accept somewhat lower yields than they now require.

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6. Congressional Budget Office, *Efficient Investments in Wastewater Treatment Plants* (June 1985).

Borrowers of small amounts pay more because some borrowing costs (bond counsel fees, printing, and so forth) are only loosely related to the amount borrowed. Further, many of the more innovative methods of financing can be tapped only by larger offerings. And infrequent borrowers must compensate for the fact that lenders often perceive borrowers without established borrowing records as more risky than others who have been in the market for a while.

The federal government could lower these borrowing costs by subsidizing a financial entity that would purchase state/local bonds and resell them in some standard format. By transforming a plethora of bond types into a standard bond, the intermediary would eliminate the current heterogeneity of municipal bonds and facilitate their resale. Such a program could lower the borrowing costs of small and infrequent borrowers, much as do existing state bond banks, since loans would be resold in large amounts. Indeed, such a program could reduce borrowing costs more than could a single state bond bank, since it would pool risk over both a wider geographic area and a broader class of borrowers.

The federal government could subsidize the repackaging of municipal debt in a variety of ways: by establishing an off-budget, government-sponsored enterprise that would repackage specific types of municipal debt; by creating an on-budget federal agency that would guarantee bonds backed by pools of state/local infrastructure bonds; or by providing grants to private firms in exchange for an undertaking by those firms to securitize (that is, issue new securities backed by) specific classes of infrastructure bonds. Each of these approaches would make state and local infrastructure debt more marketable. The approaches would differ principally in the control that the Congress would retain over both the magnitude of the subsidy provided and the types of securities that would be eligible for the subsidy.

The federal government has previously established, with widely varied success, government-sponsored enterprises (GSEs) to improve the secondary markets for loans in housing, education, and farming.[7] If history is a guide, establishing a GSE for infrastructure bonds

7. The benefits and costs of GSEs are reviewed in Thomas H. Stanton, *Government Sponsored Enterprises: Their Costs and Benefits as Instruments of Federal Policy* (Washington, D.C.:

(Continued)

would lower state and local borrowing costs, but also leave the Congress little control over the budget consequences of the GSE's actions. The principal effect on costs would arise from a federal guarantee that investors would impute to the GSE's bonds. Even if legislation explicitly disavowed any federal responsibility for the GSE's debt, investors would treat the bonds as if they were the debt of a federal agency, with backing nearly as good as the "full faith and credit" that lies behind Treasury bonds.

In the past, investors have found many reasons for ignoring disclaimers of federal guarantees of GSE debt. Lenders have found some of these reasons in Congressional action. For example, the Congress recently provided a multibillion-dollar refinancing of the Farm Credit System--a nominally private GSE lacking federal debt guarantees. The federal government also has been willing to help even nonfinancial private corporations (such as Lockheed and Chrysler) in an effort to avoid the disruption that might follow the collapse of a large firm. Buyers of debt from an infrastructure GSE would be likely to assume that similar assistance would lie behind the GSE's bonds.

Investors also have found federal debt guarantees inherent in the structure of the GSE itself. Most important are the tangible benefits available to GSEs, such as: a line of credit at the Treasury; the ability to issue bonds that bank regulators often treat as being as secure as Treasury bonds; and the ability to issue bonds that are exempt from the securities laws intended to protect investors (lenders have taken this exemption as a sign that the Congress believes the debt of these GSEs to be more secure than other privately issued debt--a belief that can be rationalized by assuming a Congressional willingness to provide needed financial support, but not, in general, by the GSE's balance sheet).

A GSE for infrastructure would thus reduce borrowing costs primarily through the subsidy inherent in an implied federal guarantee for its bonds. Since the government's contingent liability would not

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7. Continued

Association of Reserve City Bankers, April 1988); *The Budget of the United States Government, Fiscal Year 1989, Special Analysis F*; Congressional Budget Office, *Government-Sponsored Enterprises and Their Implicit Subsidy: The Case of Sallie Mae* (December 1985); and Michael Moran, "The Federally-Sponsored Credit Agencies: An Overview," *Federal Reserve Bulletin* (June 1985), pp. 373-388.

appear in the unified budget, the cost of the subsidy would be difficult to control through the budget process.

The Congress would retain greater control over the magnitude of the subsidy provided to infrastructure bonds and would be better able to target the subsidy to particular beneficiaries were it to establish a federally owned, on-budget agency to guarantee securities backed by pools of state and local infrastructure debt. As with a GSE, the Congress could attempt to target the benefits provided by this agency by specifying the types of securities eligible for repackaging (restrictions could be placed on the issuer and on the size and purpose of preferred debt). The subsidies delivered by an on-budget agency, unlike those of a GSE, would be provided through the normal budget process, and thus would be subject to greater Congressional oversight and control.

The assistance provided by either a GSE or an on-budget agency would be complicated by the fact that the federal government already subsidizes municipal debt by exempting from federal income taxes all interest earned from most municipal bonds. If the GSE issued taxable bonds (as do all existing GSEs), it would require an appropriation each year to make up for ongoing losses, since the comparable tax-exempt debt that it bought would earn less than the taxable bonds that it sold. Similarly, if an on-budget agency guaranteed taxable bonds backed by tax-exempt infrastructure debt, a federal subsidy would be required to cover the difference between taxable and tax-exempt debt. The alternative--to have the program issue tax-exempt debt--may at first glance appear to be cost-free. Yet, tax-exempt debt would lower federal revenues by increasing the amount of tax-exempt debt outstanding (and so increasing the amount of interest income sheltered from federal income taxation). Issuance of tax-exempt, federally guaranteed debt also would be at odds with a longstanding Congressional policy to discourage such debt instruments. Such debt would compete directly with Treasury bonds and, if issued in large volume, would increase the cost of all federal borrowing.

The federal government need not rely on a new agency, whether off-budget or on-budget, to subsidize municipal infrastructure debt. The government could instead provide grants to private firms in exchange for an undertaking to securitize specific classes of infrastructure bonds. The government's cost would then be limited to the capital grants; the government's role would be limited to oversight

and regulation of the firms to be sure that they securitized the required types of bonds and passed the savings through to state and local borrowers; and, as with an on-budget agency, the amount of the subsidy would be controlled by the budget process.

Change Procedures of Existing Federal Agencies

Competition among the various types of infrastructure could be increased within the current program structure by improving and making routine the information that individual federal agencies are required to provide the Congress.[8] This information might include:

- Broadening the context of budget requests to that of a development plan;
- Using agency reports to examine the past effectiveness of policies; and
- Altering the format of budget requests to require project evaluations in which all agencies use a common methodology.

These policies would require agencies to generate specific, budget-oriented reports. They would be distinct from those in common use now, however, in that they would evaluate spending requests in relation to larger program goals.

To provide a more informative context for legislative consideration of requests, the Congress could require agencies to prepare plans outlining the long-term goals of individual infrastructure programs, and specifying how those goals could be achieved, when, and at what cost. Such plans would provide the Congress with a ready system for measuring progress and assessing possible adjustments. The drawback of such plans is that they can be difficult to change.[9] Planning

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8. A full discussion of these issues can be found in Congressional Budget Office, *Federal Policies for Infrastructure Management*, pp. 91-98.

9. For an example, see General Accounting Office, "Water Projects Construction Backlog--A Serious Problem with No Easy Solution" (January 26, 1983).

must balance the need for consistent purpose against the need for flexibility.

Using consistent parameters to evaluate projects in different federal infrastructure agencies would greatly assist in making agency budget requests more informative. These parameters might include the cost of capital, the discount rate, and the value of time (when computing the cost of delays) or of human life. Requiring agencies to use the same evaluation parameters would make it easier for the Congress to allocate resources among different types of infrastructure.

Finally, requiring agencies to submit periodic evaluations of past investments (either by general groups of projects or by types of financing arrangements) could indicate how well management was performing and could alert the Congress to the need for improvement. Yet, federal managers might regard the evaluation process as divisive. Further, personnel closely involved in program administration might have difficulty in making objective assessments of a program's performance. Assigning the review process to an outside body, however, might sacrifice much of the benefits of this option, for a reviewer's findings might be subject to debate or negotiation with the program agency under scrutiny.

Create a National Infrastructure Fund

The federal government could merge all of its infrastructure spending into a single National Infrastructure Fund (NIF). A NIF could take many forms; the one considered here--an agency that would negotiate assistance in the form of grants after evaluating proposed projects--would give the government greater control over the distribution of funds between and within the different infrastructure modes.

By comparing projects in different modes, and providing assistance that varied with the national interest in particular projects, a NIF could improve the allocation of federal infrastructure resources. For example, a NIF could target federal funds to particular regions or populations better than the existing categorical programs. Such an agency also would standardize government analyses of all federal infrastructure projects, thereby providing a better guide to choosing among different projects.

There would be drawbacks, however, to a NIF that gave out money on a project-by-project basis. Most important, guaranteeing a measure of political independence for the NIF might prove difficult. The very forces that make narrow categorical grants more difficult to control than block grants would be magnified with an agency empowered to subsidize not just specific modes but specific projects.

APPENDIX

THE REPORT OF THE NATIONAL COUNCIL ON PUBLIC WORKS IMPROVEMENT

The National Council on Public Works Improvement was established by the Public Works Improvement Act of 1984 (Public Law 98-501) to assess the state of the nation's infrastructure. The Council's final report, *Fragile Foundations: A Report on America's Public Works* (1988), brings together a wide literature and makes policy recommendations in five broad areas: the level of infrastructure investment needed to ensure continued economic growth; methods of financing infrastructure; the roles of federal, state, and local governments in providing infrastructure; improving the efficiency of infrastructure services; and promoting research and development in public works. The Public Works Improvement Act also required the Congressional Budget Office to review the Council's findings. The main study reviews some of the issues raised by the Council, and this appendix focuses more specifically on its findings.

HOW MUCH INVESTMENT?

The Council explores first the issue that is least tractable: how much must the nation invest each year in public works in order to "sustain future economic growth?" The Council notes that few specifics are known of the relation between infrastructure and economic growth. The economics literature supports a conclusion that some infrastructure is necessary for economic growth, but little is known about how much is necessary for a particular level of growth. Nonetheless, the Council concludes that national infrastructure outlays should be increased by as much as 100 percent. No direct explanation is offered for this recommendation. Instead, the Council presents a series of heuristic arguments designed principally to show that the demand for infrastructure exceeds, or soon will exceed, the likely available supply. The arguments offered by the Council all have serious limitations, not only as a guide to the sufficiency of existing public works spending but also

as a means of establishing investment priorities among different kinds of infrastructure.

The Council's Arguments for More Investment

The Council's recommendation for a large spending increase rests largely on three sets of statistics. The Council first cites the infrastructure "needs" estimated by the Association of General Contractors, the Joint Economic Committee, and the Congressional Budget Office. These studies, from the early 1980s, show annual investment requirements, in 1982 dollars, of $118.2 billion, $64.3 billion, and $52.6 billion, respectively (see the Appendix Table). With 1986 infrastructure capital spending by all levels of government equaling $46 billion (in 1982 dollars), each of these estimates implies a substantial shortfall of investment.

Second, the Council estimates future industrial demand for infrastructure services. On the assumption that infrastructure use per dollar of output will remain unchanged for each industry, the Council concludes that industry's infrastructure use will increase by more than 30 percent during the next 10 years.

Finally, the Council notes that, between 1960 and 1985, capital outlays for infrastructure declined as a percentage of both gross national product (GNP) and private investment--from 2.3 percent of GNP to 1.1 percent, and from about 15 percent of total private investment to 7 percent.

These statistics indicate to the Council that national public works investment is inadequate to sustain future economic growth. But the data are open to various interpretations. The relation between infrastructure investment and GNP is poorly understood; economic theory provides no indication of the optimal level of infrastructure investment relative to GNP. The Council nonetheless assumes that the decline in public works outlays relative to GNP and private investment endangers economic growth. Its recommendation to double infrastructure spending implicitly assumes that sustained economic growth requires a constant proportion of GNP to be devoted to infra-

APPENDIX TABLE. ANNUAL INFRASTRUCTURE INVESTMENT NEEDS (In billions of 1982 dollars)

Infrastructure Category	Association of General Contractors	Joint Economic Committee	Congressional Budget Office
Highways and Bridges	62.8 [a]	40.0	27.2
Other Transportation (Mass Transit, Railroads, Airports, Ports, Locks, Waterways)[b]	17.5	9.9	11.1
Drinking Water	6.9	5.3	7.7
Wastewater Treatment	25.4	9.1	6.6
Drainage	5.6	[c]	n.a.
Total	118.2	64.3	52.6

SOURCE: The National Council on Public Works Improvement, *Fragile Foundations: A Report on America's Public Works*, from Association of General Contractors, *America's Infrastructure*; Joint Economic Committee, *Hard Choices* (February 1984); and Congressional Budget Office, *Public Works Infrastructure* (May 1983).

NOTE: n.a. = not available.

a. Highways only. Bridges were estimated separately at an additional, one-time repair cost of $51.7 billion.

b. The JEC study excluded needs for locks and waterways; the CBO study excluded needs for railroads.

c. Included under wastewater treatment.

structure investment and that this proportion is roughly that which existed in 1960 (the base year of the period under consideration). There are a number of reasons to question this judgment.

First, the optimal level of infrastructure investment relative to GNP will depend, in part, on the efficiency of infrastructure use. Policies that lead to more efficient use of infrastructure will reduce the amount of infrastructure needed per dollar of GNP (or of private investment). Examples of efficiency-enhancing infrastructure policies include:

- Using bus fleets rather than rail systems in all but the most densely populated localities;

- Establishing lanes for high-occupancy vehicles to increase roadway capacity during commuting hours;

- Consolidating small water-supply systems into regional systems that can substantially reduce the unit cost of drinking water; and

- Imposing fees for use of the air traffic control system, similar to peak-period landing fees already used at some airports, to increase the amount of traffic that the aviation system can handle.

These and other innovations would improve the productivity of public works capital and reduce the amount of investment needed to provide a given level of infrastructure services.

Second, the optimal level of public works investment should be expected to vary with the structure of the economy. The observed decline of infrastructure investment relative to GNP reflects, to some extent, the growing importance of services in the economy. For each dollar of GNP generated, the service and financial sectors require fewer transportation services and generate less pollution (thus requiring less environmental infrastructure) than does the manufacturing sector. As the relative importance of the service and finance sectors continues to grow, a smaller proportion of GNP needs to be devoted to infrastructure investments.

Finally, the country may not need as much new infrastructure investment as it once did. The relative decline in investment since the 1960s may reflect a transition from an era of construction to an era of management in public works. New Interstate highway construction, for example, generally provides a lower rate of return than does maintenance of the existing system.[1] A Bureau of Reclamation study recently concluded that, in many instances, the Bureau could ensure adequate water supplies most efficiently by concentrating on water

1. See Chapter I for estimated rates of return on highway spending of different kinds.

management and conservation rather than on construction.[2] In many instances, public objectives may be achieved more efficiently by improving management practices than by raising new construction outlays to the level of the 1960s. In short, the changing nature of infrastructure needs, and the lower returns to some infrastructure investment, make past investment levels a poor guide to future spending.

The "needs" and "use" studies cited by the Council are equally problematic. Needs studies tend to overstate required spending since they merely reflect the cost of repairing facilities to a given engineering standard, regardless of whether the benefits exceed the costs involved.[3] A study of water resources "needs," for example, might include the cost of building all of the projects that the Congress has authorized to be constructed. Yet, in 1986, the Corps of Engineers' budget request included 34 projects, with an expected final cost of $4.4 billion, that promised benefit-cost ratios of less than one when evaluated at a 10 percent discount rate.[4] Needs studies also ignore the savings possible from more productive use of existing capital--savings that can be substantial. Finally, both the "needs" and "use" studies inflate required spending by assuming that both technology and existing pricing policies will remain unchanged.

The Council's report contains numerous examples of the way in which new technologies and pricing policies can alter infrastructure demand.[5] To cite only one, the Council notes that when New York's Kennedy and La Guardia airports increased their landing fees, peak-period general aviation traffic fell by 30 percent, and peak-period delays in take-offs and landings declined by 50 percent. The Council's "needs" and "use" estimates would have been more useful if they had noted how infrastructure demand would change under the various policy reforms recommended by the Council.

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2. Department of Interior, Bureau of Reclamation, *Assessment '87* (1987).

3. A recent critique of needs studies can be found in Office of Management and Budget, "Supplement to Special Analysis D" (May 1988).

4. See Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986), pp. 39-40.

5. See the discussions on pp. 40-41 and 61-63 of National Council on Public Works Improvement, *Fragile Foundations: A Report on America's Public Works* (1988).

In the end, the Council's argument for a doubling of spending rests on a series of data whose true import is hard to fathom. Even if the data are taken to indicate that greater infrastructure investment is desirable, they provide no information about which infrastructure problems should be regarded as most pressing. And, in fact, the Council sets no priorities, either between or within infrastructure modes.

Estimating Rates of Return

Given the ineluctable uncertainties in "needs" and "use" studies, policymakers may wish to consider other information when deciding on priorities and investment levels. In this regard, estimates of the rates of return from different infrastructure investments could be particularly useful, although the Council rejects the use of such studies when evaluating the existing infrastructure stock.

The Council finds four principal drawbacks to rate-of-return studies.[6] First, it argues that these studies would require far more data collection than is now used to support program decisions. But most federal (if not state and local) agencies now collect data sufficient to compute rate-of-return analyses on infrastructure investments. The estimated rates of return on highway spending cited earlier in this volume were based on data published by the Federal Highway Administration. The Corps of Engineers, the Bureau of Reclamation, and the Soil Conservation Service routinely compute benefit-cost ratios--the informational equivalent of rates of return--for the water resources projects that they undertake. And the Urban Mass Transportation Administration now collects the data needed to estimate rates of return on new transit starts.

Second, the Council expresses concern that rate-of-return studies ignore unquantifiable benefits from infrastructure investments, such as improved national defense. Yet, policymakers need not exclude unquantifiable benefits from consideration simply because they have at hand a measure of a project's quantifiable benefits. It is hard to see, for example, how Congressional allocations of federal-aid highway funds could be harmed by the knowledge that, in addition to national

6. *Fragile Foundations*, p.51.

defense benefits, projects that merely would maintain the current condition of these highways would have rates of return estimated at between 30 percent and 40 percent, while projects that would fix all of the deficiencies would have negative estimated rates of return.[7]

Third, the Council argues that rate-of-return studies usually understate the benefits of public investment, since they ignore the effect of public capital on the productivity of private-sector capital. In fact, the rate-of-return studies made by federal agencies explicitly take into account the benefits to private entities. The Corps of Engineers' evaluations of lock and dam projects, for example, usually attempt explicit measurements of the benefits to shippers. Similarly, water project evaluations by the Bureau of Reclamation include estimates of the projects' value to farmers.

Finally, the Council states that measuring rates of return is not useful "because it is difficult to . . . value future public benefits." In fact, the theory of measuring future public benefits has long been well developed.[8] While current estimating practices might be improved, such estimation is not inherently intractable. The argument in favor of less-than-perfect estimates of rates of return is not that they eliminate uncertainty, but only that they can reduce it. And, of course, one could develop a range of rates of return to reflect the uncertainty in these estimates.[9]

This is not to suggest that rate-of-return analyses should be the sole or even primary determinant of infrastructure investment priorities. Many truly unquantifiable considerations have gone into such decisions in the past, for infrastructure investment has been designed to achieve a variety of social goals such as mobility (and the social, economic, and cultural integration that mobility might bring about) and income redistribution. Moreover, rate-of-return analyses can help the Congress little in deciding how to allocate funding between infra-

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7. See Chapter I of this report.

8. See the discussion and citations in Richard Tresch, *Public Finance: A Normative Theory* (Plano, Texas: Business Publications, Inc., 1981).

9. For a rate-of-return study that includes a range of outcomes reflecting the uncertainty surrounding the estimates, see Congressional Budget Office, *Improving the Air Traffic Control System: An Assessment of the National Airspace Plan* (August 1983).

structure investment and social welfare programs, since the benefits of the latter are more difficult to measure.

METHODS OF FINANCING INFRASTRUCTURE

The Council recommends that beneficiaries pay a greater portion of infrastructure costs, and it reviews various ways by which this might be accomplished. The Council carefully reviews the benefits and limitations of such a policy. User fees, in particular, offer managers important information about the demand for facilities; provide infrastructure users with incentives to use facilities efficiently; and can produce the revenue stream needed for timely maintenance, rehabilitation, and replacement of facilities. The usefulness of fees is limited, however, if public works are intended to redistribute income, or if subsidies are needed to correct externalities (as in the case of wastewater treatment grants that compensate localities for the benefits they provide to others on a common waterway by treating municipal wastes).

Mechanisms Other Than User Fees

The Council considers a number of mechanisms in addition to the direct application of user fees by which the "beneficiary pays" principle could be carried out. These include earmarked revenues, the creation of special districts or authorities, and the use of infrastructure trust funds. The Council finds that each has its advantages and disadvantages.

Earmarked revenues and trust funds can improve support for infrastructure finance by offering voters a more distinct link between benefits and costs. Yet, if insulated from general-purpose budget pressures, these funding mechanisms can bind lawmakers to outdated priorities; and if not isolated from these budget pressures, they are not likely to be more effective than existing financing mechanisms.

Special districts that have both independent revenue sources and boundaries drawn to take advantage of the economies of scale can provide infrastructure services more cheaply than some multipurpose governments. The Council concludes, however, that a lack of indepen-

dent revenue sources, inadequate accountability to voters, and poorly drawn boundaries have made existing districts, on average, no more efficient as infrastructure providers than the average multipurpose government.

Most generally, the Council's discussion indicates that while these devices may be useful in some circumstances, none can substitute for a political consensus on the proper amount of infrastructure.

Effects of Tax Reform

The Council also reviews the effect of the 1986 Tax Reform Act (TRA) on state and local infrastructure finance. The principal tax subsidy for state and local infrastructure investment is provided by the exemption from federal income tax of interest paid on some state and local bonds. The TRA included a host of provisions that, taken individually, would have limited the value of this subsidy. But many of these provisions will have offsetting consequences, so that taken together their effect will be less substantial.[10] The Council report reviews the TRA provisions that restricted the value of this subsidy, and urges the "removal of unwarranted limits on the ability of state and local governments to help themselves through tax-exempt financing." But the Council neither specifies the federal tax provisions that it considers unwarranted nor addresses the question of whether tax subsidies are more efficient than direct outlays as a way for the federal government to support public works investment.

GOVERNMENT ROLES

The Council surveys the existing roles of federal, state, and local governments in providing infrastructure, and reviews the literature on the different role that each level of government might play. The Council concludes that while "policy should support local self-sufficiency to the greatest extent possible," all levels of government should

10. See statement of Edward Gramlich, Acting Director of the Congressional Budget Office, before the Subcommittee on Investigations and Oversight, Committee on Public Works and Transportation, September 17, 1987.

share some degree of accountability for infrastructure as a whole, since the effects of most public works "are not neatly locked within the boundaries of any given jurisdiction." The Council would assign primary responsibility for infrastructure as follows:

- *Federal*: highways of "national significance"; air traffic control; inland waterways; environmental standards; hazardous waste cleanup; flood control.

- *State*: highways of "statewide significance"; wastewater treatment capital outlays; airport planning; waste disposal siting; dam safety.

- *Local*: local roads and bridges; mass transit; airports; ports and harbors; water supply; wastewater treatment operations and maintenance outlays; solid waste disposal; water supply.

The Council also reviews the variety of ways in which the federal government can subsidize state and local infrastructure outlays. The effects of these subsidies often differ not only with their amount but with their form. While the Council notes the incentives offered by optimally designed subsidies, it ignores the incentives of those that are imperfectly set. It notes, for example, that categorical matching grants could be the most effective way for federal subsidies to increase state and local outlays for a particular kind of infrastructure. Yet, existing infrastructure matching grants are "closed"--that is, the government matches state and local spending only up to a predetermined amount. Econometric studies have consistently found that the combination of high matching rates and low ceilings on the amount that the federal government will match has allowed grant recipients to use much of the federal money as a substitute for, not complement to, their own spending.[11]

11. This literature is reviewed in Congressional Budget Office, *Federal Policies for Infrastructure Management* (June 1986).

EFFICIENCY OF PUBLIC WORKS SPENDING

The Council explores a number of policies designed to improve the efficiency of infrastructure outlays.[12] The proposals include:

- Choosing solutions from a broader range of infrastructure projects;
- Evaluating alternative infrastructure projects in a more consistent fashion;
- Using more timely operations and maintenance outlays to minimize the cost of infrastructure services;
- Greater use of nonstructural alternatives such as demand management; and
- Regional cooperation to take advantage of the economies of scale present in many kinds of infrastructure investments.

The Council argues that states and localities could be encouraged to adopt these policies by limiting the restrictions placed on the use of federal infrastructure grants. The arguments for and against this approach are discussed in Chapter VI above. The Council makes no estimate of how such efficiency measures might affect the desired level of public works investment.

PROMOTING RESEARCH AND DEVELOPMENT

The Council reviews the various reasons why private firms tend to underinvest in public works research and development. Most important, a firm cannot garner for itself the benefits of its research, since others cannot be prevented from appropriating the results of its R&D. In addition, common infrastructure procurement practices fail to give private firms incentives to develop cost-minimizing methods

12. Most of these policies are evaluated in Congressional Budget Office, *Federal Policies for Infrastructure Management.*

and materials, since these practices often emphasize initial costs rather than life-cycle costs.[13]

Because of these problems, the federal government funds a number of infrastructure research efforts. The Strategic Highway Research Program funds research aimed at improving the productivity of paving and bridge materials; and the Congress recently enacted legislation that would establish a university-affiliated transportation research center in each of 10 regions. Federal agencies also help spread research results through programs such as the Department of Transportation's technology-sharing program. The Council urges the creation of a new national research program, with an emphasis on coordinating and setting priorities for existing research efforts.

13. The economic and social barriers to infrastructure innovation by private firms are detailed in Office of Technology Assessment, *Construction and Materials Research and Development for the Nation's Public Works* (June 1987); and National Research Council, *Infrastructure for the 21st Century* (Washington, D.C.: National Academy Press, June 1987). These reports lay the basis for the Council's recommendations.

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